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ABSTRACT

This series of learning activity packages focuses on four areas of tractor mechanics: (1) maintaining and servicing the power train, (2) maintaining and servicing the clutch, (3) maintaining and servicing the transmission and differential, and (4) maintaining and servicing the final drive. Each of the twenty-nine illustrated learning activity packages follows a typical format: introduction, directions, objectives, learning activities, tools and equipment needed, materials and supplies needed. safety, instructions, student self-check, check-out activities, and final instructor checklist. (LRA)

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TRACTOR MECHANICS

MAINTAINING AND SERVICING THE POWER TRAIN
LEARNING ACTIVITY PACKAGES 49 - 53

MAINTAINING AND SERVICING THE CLUTCH
LEARNING ACTIVITY PACKAGES 54 - 59

MAINTAINING AND SERVICING THE TRANSMISSION AND DIFFERENTIAL
LEARNING ACTIVITY PACKAGES 60 - 68

MAINTAINING AND SERVICING THE FINAL DRIVE
LEARNING ACTIVITY PACKAGES 69 - 77

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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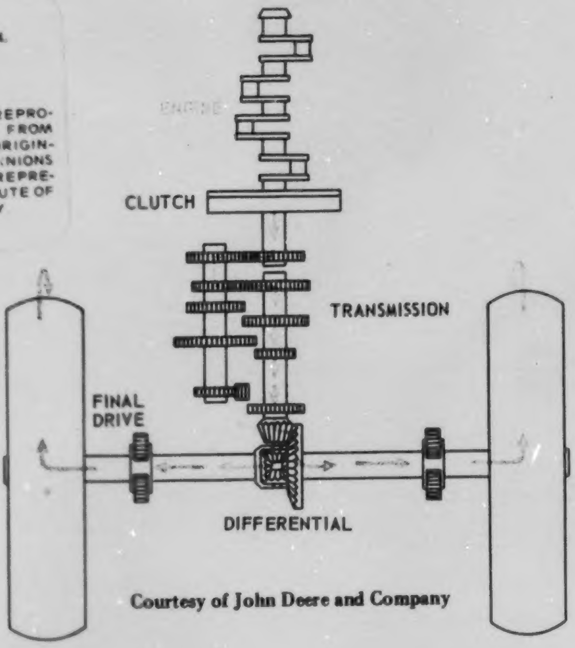

Courtesy of John Deere and Company

State Department of Education
Office of Vocational Education
Agricultural Education Section
Columbia, South Carolina 29201

In Cooperation With

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Clemson, South Carolina 29631

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TRACTOR MECHANICS

Learning Activity Package Number	Objective Numbers	Learning Activity Package Title
DUTY: MAINTAINING AND SERVICING THE POWER TRAIN		
49.	16	Servicing the Power Take-Off
50.	19	Servicing Universal Joints
51.	13	Servicing the Drive Shaft
52.	17	Servicing the Special Drives
53.	4, 18	Servicing Torque Convertors
DUTY: MAINTAINING AND SERVICING THE CLUTCH		
54.	137	Adjusting Clutch Free Play
55.	138	Servicing a Dry Clutch
56.	142	Servicing a Wet Clutch
57.	139	Servicing an Expanding Shoe Clutch
58.	140	Servicing a Magnetic Clutch
59.	141	Servicing Overrunning Clutches
DUTY: MAINTAINING AND SERVICING THE TRANSMISSION AND DIFFERENTIAL		
60.	161, 162, 163	Adjusting a Gear Train
61.	166	Servicing a Sliding-Gear Transmission
62.	164	Servicing a Constant-Mesh Transmission
63.	165	Servicing the Power-Shift Transmission
64.	169	Repairing Differentials
65.	171	Servicing Differential Locks
66.	167	Adjusting Ring Gear and Pinion
67.	168	Preloading Axle Bearing
68.	170	Replacing Axle Seal and Gaskets

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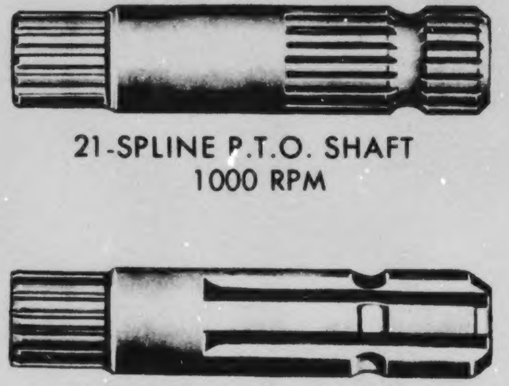
TRACTOR MECHANICS

Learning Activity Package Number	Objective Numbers	Learning Activity Package Title
DUTY: MAINTAINING AND SERVICING THE FINAL DRIVE		
69.	173	Adjusting Endplay on the Final Drive
70.	174	Servicing Bearings in Final Drive
71.	175	Servicing a Pinion Final Drive
72.	176	Servicing a Planetary Final Drive
73.	172	Servicing a Chain Final Drive
74.	134	Packing Wheel Bearings
75.	1, 2	Adjusting Wheel Bearings
76.	3	Inspecting Tires
77.	11	Repairing Brake Assemblies

Learning Activity Package Number 49



21-SPLINE P.T.O. SHAFT
1000 RPM

6-SPLINE P.T.O. SHAFT
540 RPM

Power take-off shafts for 1,000 rpm have 21 splines on the end where the implement connects. Those for 540 rpm have 6 splines.

Courtesy of the American Association
for Vocational Instructional Materials

Servicing the Power Take-off

Tractor Mechanics

Objective no. 16

INTRODUCTION

All modern tractors have power take-off drive mechanisms; these are attachments in the power trains which are used to supply power to equipment pulled by or attached to the tractor. There are four types of power take-off drives in use today: (1) transmission driven, (2) continuous running, (3) independent, and (4) relative ground speed. Two speeds are available: 540 RPM (with a six-spline shaft) and 1000 RPM (with a 21-spline shaft). In this learning activity package you will learn more about each of these types of power take-off drives and how to service them.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a tractor with power take-off drive and necessary tools and supplies, service the power take-off drive. The service should include the completion of all the steps on the instructor's checklist.

LEARNING ACTIVITIES

1 READ *Tractor Operation and Daily Care* (AAVIM), pp. 68 through 71.

(or) ______________________________

2 READ *Fundamentals of Service: Power Trains* (John Deere Co.), Chapter 9, pp. 9-1 through 9-8.

(or) ______________________________

3 TEST YOUR KNOWLEDGE of power take-off drives by taking Student Self-Check I, UNDERSTANDING THE POWER TAKE-OFF.

4 READ the section on power take-offs in the manufacturer's service manual.

(or) The I & T Shop Manual

5 PRACTICE servicing the power take-off following the outline in Instructions, SERVICING THE POWER TAKE-OFF DRIVE, and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES

Cleaning solvent
Cleaning rags
Recommended oil

SAFETY

Make sure engine is not running or PTO engaged before servicing.

INSTRUCTIONS

SERVICING THE POWER TAKE-OFF DRIVE

In servicing the power take-off drive, the following procedure should be used:

1. Set wheel brakes.
2. Disengage power to power take-off shaft.
3. Shut off engine.
4. Remove cap from end of power take-off shaft.

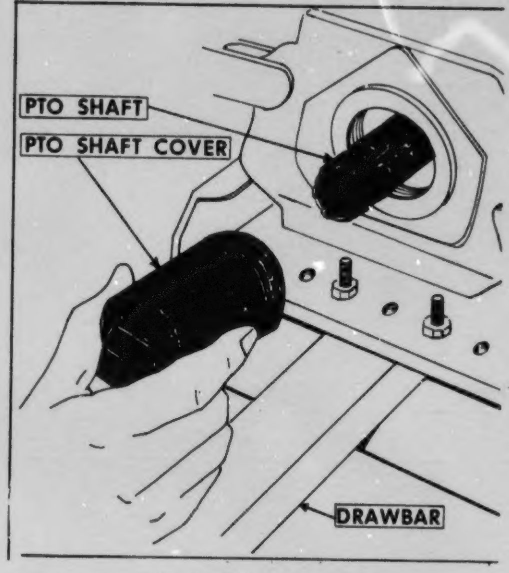


Figure 1. Removing the PTO shaft cover.

Courtesy of the American Association for Vocational Instructional Materials

5. Check tractor power take-off shaft to determine shaft speed.
6. Check to determine if splined coupling on machine is connected to power take-off.

7. Check inside spline of universal joint for foreign matter and dirt.

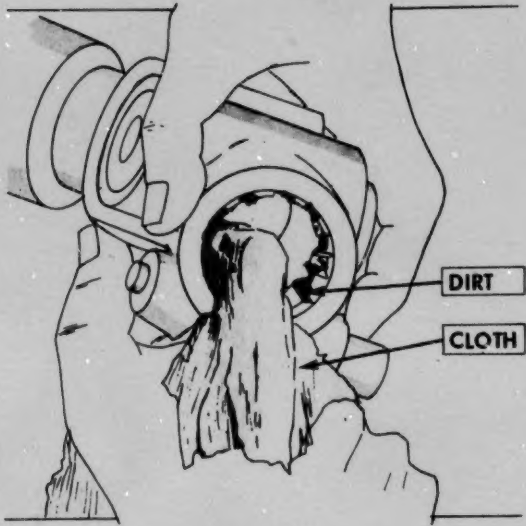


Figure 2. Use clean cloth to remove dirt from inside spline of universal joint.

Courtesy of the American Association for Vocational Instructional Materials

8. Clean and oil outside spline of tractor power shaft.

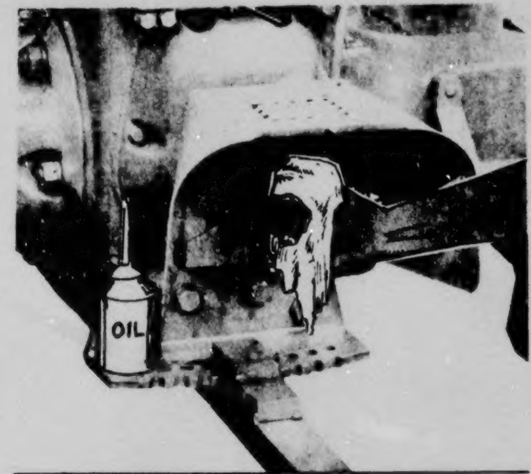


Figure 3. Cleaning and oiling the spline.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

UNDERSTANDING THE POWER TAKE-OFF

Complete the following:

1. ____________________ power take-off operates only when the tractor's clutch is engaged.
2. ____________________ power take-off operates even though the tractor is out of gear.
3. ____________________ power take-off is completely separated from the tractor's clutch.
4. The 540 TPM power take-off shaft has __________ splines.
5. The 1000 RPM power take-off shaft has __________ splines.
6. ____________________ is the cause of excess vibration while the power take-off is in operation.
7. ______________________________ or ____________________ may prevent the power take-off shaft from telescoping.
8. The ____________________ must also be in place when the power take-off is in operation.
9. ______________________________ prevents hooking at 540 RPM machine to a 1000 RPM shaft.
10. Three points of lubrication for a power take-off drive line are: ______________, ______________, and ______________.

Compare your answers with the correct responses on the following page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. Transmission driven
2. continuous running
3. independent
4. six
5. twenty-one
6. misalignment
7. worn bearings or rusted shaft
8. shield
9. number of splines in the shaft
10. telescoping drive shaft, bearings, universal joints.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE POWER TAKE-OFF DRIVE.

Service the power take-off drive on the designated tractor.

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LAP TM–49

Student ______________________

Date ______________________

SERVICING THE POWER TAKE-OFF DRIVE

Instructor's Final Checklist

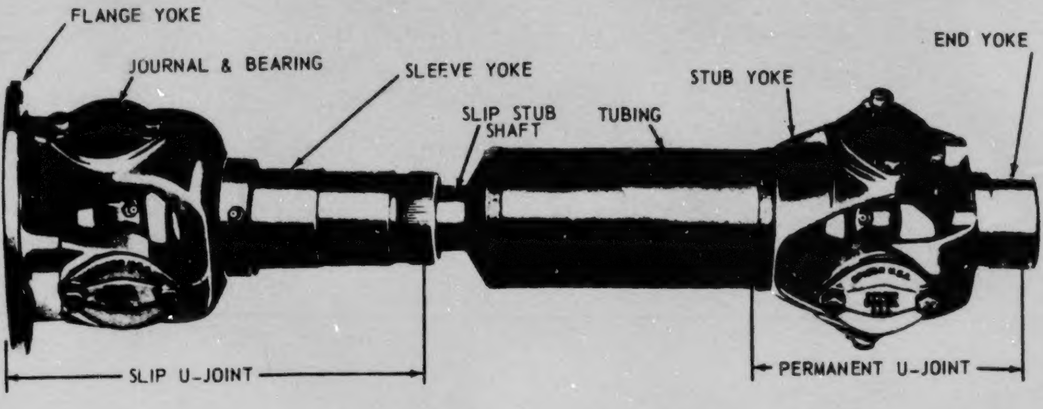
Check the student's performance in the following elements of servicing the power take-off drive.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing the power take-off drive, the student:				
1. observed safety practices in preparing the tractor for service	☐	☐	☐	☐
2. determined shaft speed	☐	☐	☐	☐
3. checked power take-off and spline couplings	☐	☐	☐	☐
4. cleaned and oiled outside spline	☐	☐	☐	☐

Learning Activity Package Number 50



Servicing Universal Joints

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 19

INTRODUCTION

Most equipment operated from the Power Take-Off (PTO) will use universal joints. Occasionally, these universal joints fail. Tractor mechanics must be able to service universal joints so that they will operate smoothly, with no binding or dragging. In this learning activity package you will learn how to properly service and repair universal joints.

DIRECTIONS

Before you begin to work on this learning activity package, be sure you have completed Package 49, "Servicing the Power Take-Off Drive."

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given new parts as needed, lubricant, a manufacturer's service manual, and the necessary tools, service a universal joint. There must be no damage to any parts. New bearings will be installed. There should be no roughness or binding in the new bearings and seals.

LEARNING ACTIVITIES

1 STUDY "Servicing U-Joints," *Tractor Operation and Daily Care* (AAVIM), pp. 71 through 74.

(or) ______________________________

2 READ *Power Trains* (John Deere Company), Chapter 9, pp. 9-3 through 9-7.

(or) ______________________________

3 CHECK YOUR KNOWLEDGE of universal joints by taking the Student Self-Check, UNIVERSAL JOINTS.

4 READ Instructions – SERVICING UNIVERSAL JOINTS.

(or) ______________________________

5 VIEW the slide-tape presentation TM-50, "Servicing Universal Joints."

(or) ______________________________

6 STUDY the manufacturer's service manual for the proper procedure in removing and installing universal joints.

(or) The I & T Shop Manual

7 PRACTICE removing and reinstalling bearings and seals in U-joints. Carefully follow the procedure outlined in Learning Activity 4 and in the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Bearing puller
Vice
Socket wrenches

MATERIALS AND SUPPLIES

Replacement bearings
Replacement journals

SAFETY

Make sure universal joints are covered to protect from loose clothing.

INSTRUCTIONS

SERVICING UNIVERSAL JOINTS

The three common types of universal joints are: (1) cross and roller, (2) ball and trunnion, and (3) constant velocity. There are several variations on each type. Check the manufacturer's service manual for specific details. The following instructions are for the cross-and-roller type.

1. Note position of grease fittings (if used) and mark the yokes in relation to the propeller shaft for reassembly purposes later.

2. Remove retainer plates (or snap rings) that hold bearings in yoke and drive shaft.

3. Place U-joint in a vise. Select a wrench socket with an outside diameter slightly smaller than the U-joint bearings, and select another wrench socket with an inside diameter slightly larger than the U-joint bearings. Place sockets at opposite bearings in the yoke so that the smaller socket becomes a bearing pusher and the larger becomes a bearing receiver.

4. Close vise jaws until both bearings are free of the yoke and remove bearings from the cross or spider. (A hydraulic press may also be used.)

5. Check service manual for detailed instructions if bearings will not come all the way out.

6. Remove yoke from drive shaft and press bearings out of the drive shaft.

7. Clean and examine all parts, replacing damaged or excessively worn parts. (If old parts are to be reassembled, pack bearing cups with universal-joint grease. If new parts are being installed, check new bearings for adequate grease.)

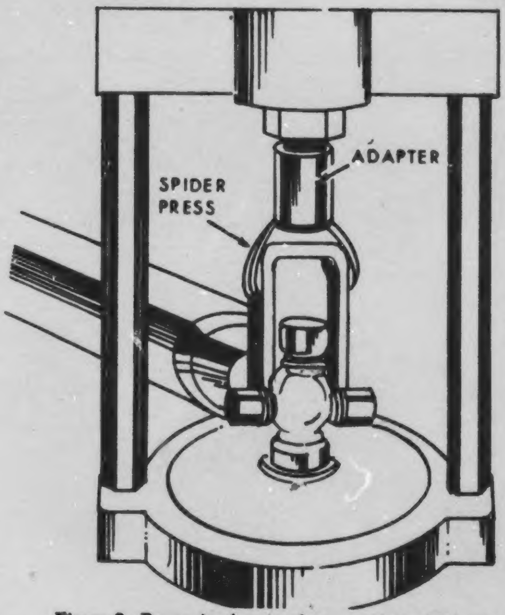

ADAPTER
SPIDER PRESS

Figure 2. Removing bearing from a universal joint using a hydraulic press.

8. With pusher socket, press one bearing part way into the drive shaft. Position spider into partially installed bearing and place second bearing into drive shaft. Note position of grease fittings.

9. Put drive shaft in vise so that bearings are in contact with vise jaws.

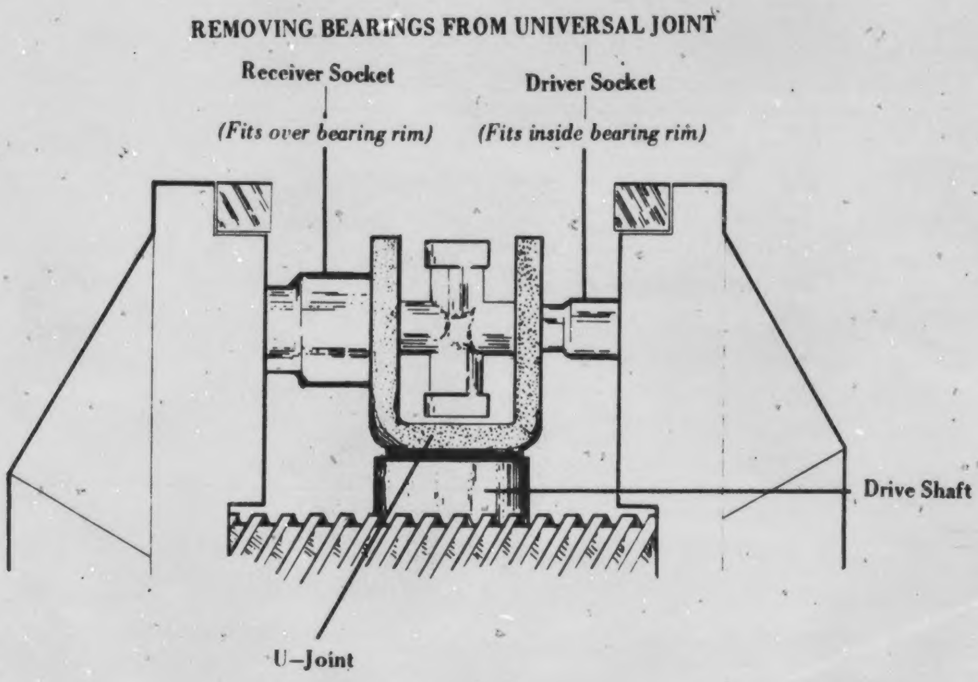

REMOVING BEARINGS FROM UNIVERSAL JOINT
Receiver Socket
(Fits over bearing rim)
Driver Socket
(Fits inside bearing rim)
Drive Shaft
U–Joint

Figure 1. Removing bearings from the universal joint using a vise.

10. Press bearings into position and install snap rings or retainer plates.

11. Install bearings in yoke in same manner. Check U-joints for roughness and binding and correct the condition if necessary prior to installation in tractor.

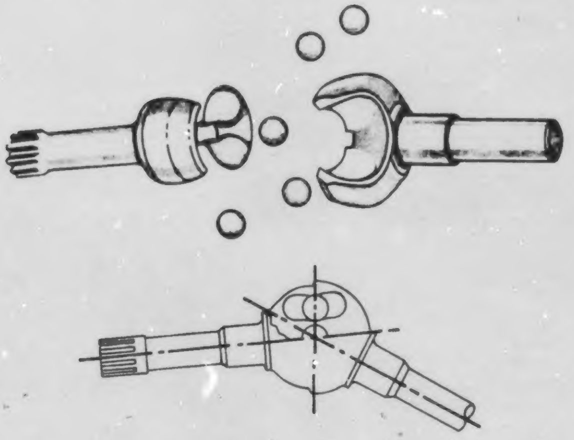


Figure 3. Universal Joint (Bendix-Weiss Type)

Courtesy of John Deere and Company

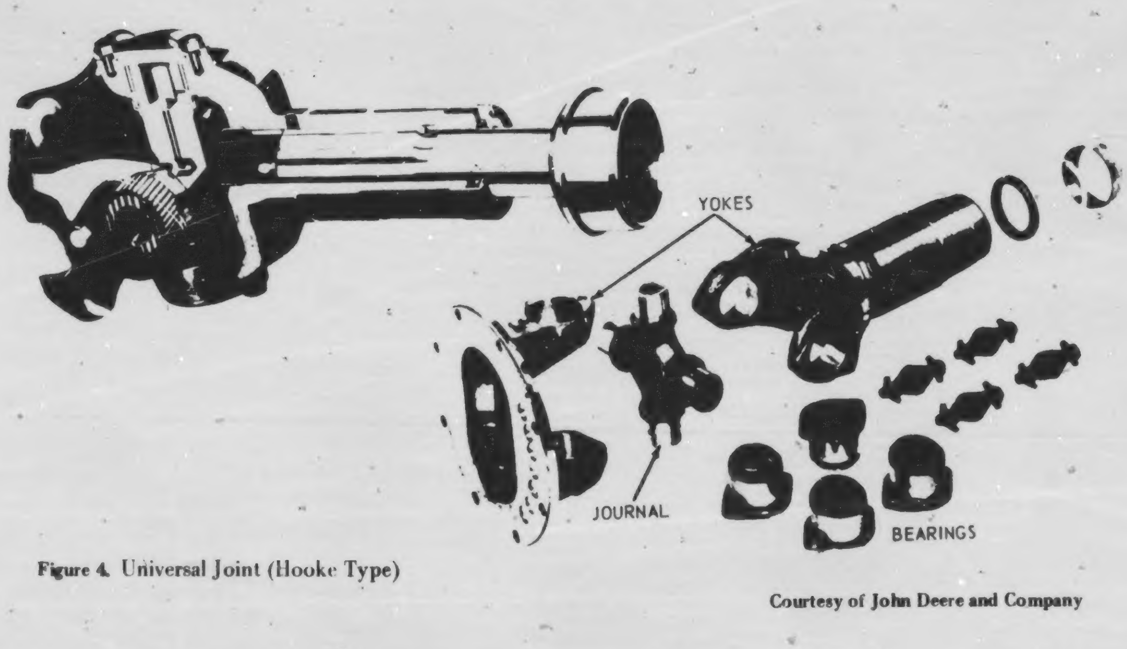


Figure 4. Universal Joint (Hooke Type)

Courtesy of John Deere and Company

STUDENT SELF CHECK

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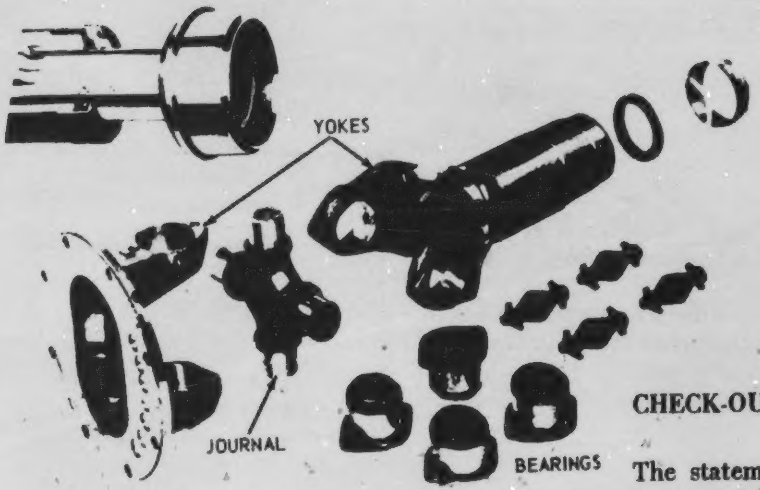
UNIVERSAL JOINTS

1. Label the universal joints shown below as the Hooke-type or the Bendix-Weiss



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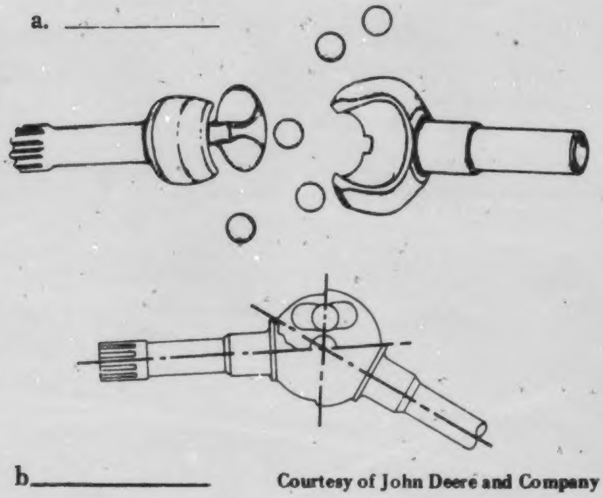
a. ______________



b.______________ Courtesy of John Deere and Company

2. List two types of drive shafts
   a.
   b.

3. List at least three safety precautions
   a.
   b.
   c.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activities you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING UNIVERSAL JOINTS.

Service a universal joint on the designated tractor.

CORRECT RESPONSES

1. a. Hooke-type
   b. Bendix-Weiss
2. a. solid
   b. telescoping
3. a. Keep shafts covered
   b. Disconnect PTO when not in use
   c. Keep clothing away from shaft

15

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LAP TM–50

Student ______________________

Date ______________________

SERVICING UNIVERSAL JOINTS

Instructor's Final Checklist

Check the student's performance in the following elements of servicing universal joints.

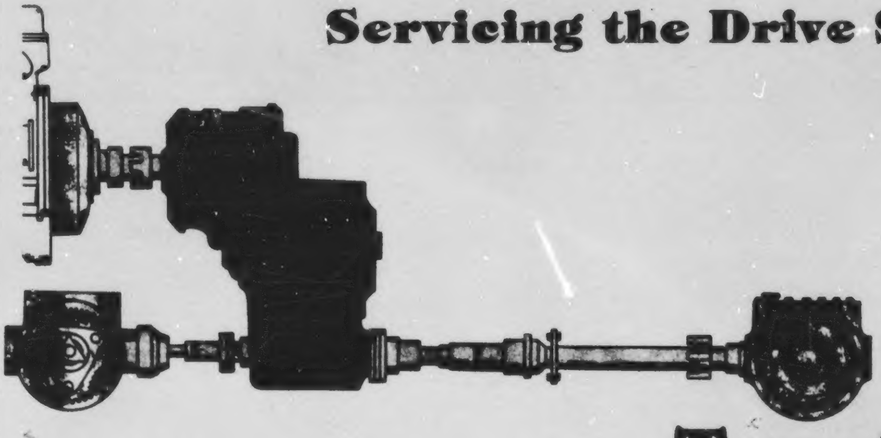
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the universal joints, the student:				
a. checked the manufacturer's service manual for proper procedure to follow	[ ]	[ ]	[ ]	[ ]
b. handled bearings and joints carefully to prevent damaging parts	[ ]	[ ]	[ ]	[ ]
c. carefully inspected all parts and replaced worn items	[ ]	[ ]	[ ]	[ ]
2. The rebuilt U-joint moved smoothly, without binding or roughness	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 51

Servicing the Drive Shaft



Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 13

INTRODUCTION

The two types of drive shafts used on the modern tractor are the telescoping shaft and the solid shaft. The telescoping shaft is variable in length and will have two or three universal joints. The solid shaft has a universal joint on each end, and is of a fixed length. A drive shaft may become corroded or damaged in use, making it inoperable and thus requiring service. In this learning activity package you will learn how to remove, clean, inspect, and repair both types of drive shafts.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, the manufacturer's service manual, shop rags, lubricants, and the necessary tools, service the drive shaft. All parts must be clean and lubricated with the recommended lubricant, and there should be no damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), Chapter 9, p. 4.

(or) ______________________________

2 READ *Tractor Operation and Daily Care* (AAVIM), pp. 72 through 73.

(or) ______________________________

3 CHECK YOUR KNOWLEDGE of drive shafts by taking the Student Self-Check, DRIVE SHAFTS.

4 READ the section on drive shafts in the manufacturer's service manual. Note the procedure in removing and servicing parts.

(or) The I & T Shop Manual

5 PRACTICE removing, cleaning, inspecting and servicing a drive shaft. Use Instructions, SERVICING THE DRIVE SHAFT, and the manufacturer's service manual.

6. ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Wire brush

MATERIALS AND SUPPLIES

Rags
Cleaner/Solvent
Lubricant

SAFETY

Be sure engine is off and all power (especially to PTO) is disengaged.

INSTRUCTIONS

SERVICING THE DRIVE SHAFT

There are two basic types of drive shafts — solid shaft and telescoping shafts. Check the service manual for your specific tractor. In servicing the drive shaft, the following procedure should be used:

1. Shut off engine and disengage all power (especially PTO).

2. Remove all parts necessary to reach drive shaft.

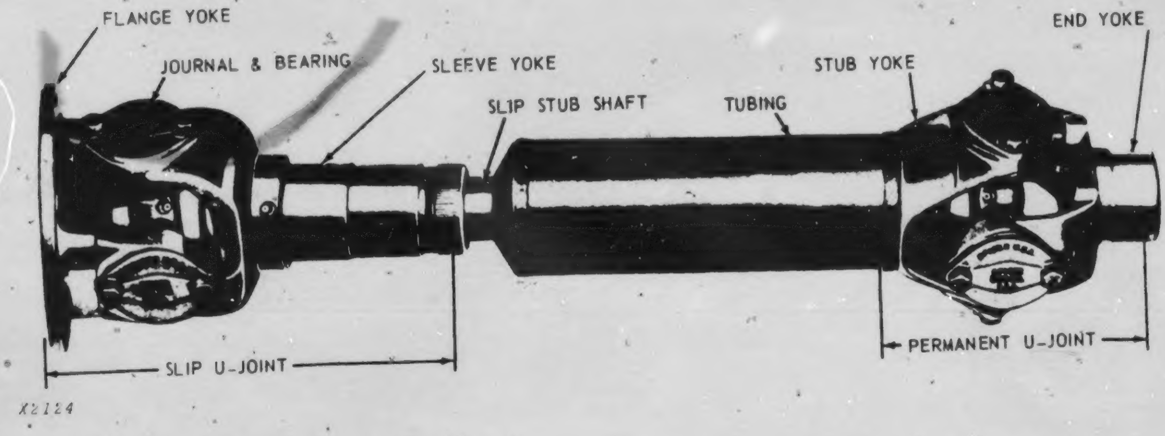


Figure 1 Telescoping PTO shaft

Courtesy of John Deere and Company

3. Clean off visible dirt with wire brush and shop rag; lubricate the drive line in the following three ways:
   a. Lubricate the telescoping drive shafts (if available on the model). Check to be sure PTO drive shaft is secured on the machine PTO shaft.
   b. Inspect and lubricate the bearings in the adjustable bearing bracket, replacing them if the bearings are worn or faulty.
   c. Inspect and lubricate the universal joints.
4. Reassemble all parts and reengage power.

STUDENT SELF CHECK
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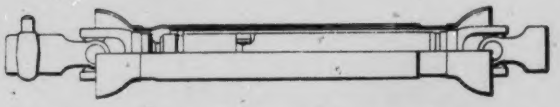
DRIVE SHAFTS

1. List the two major types of drive shafts.

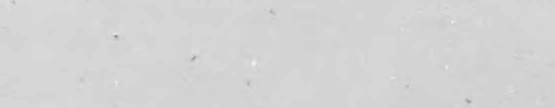
   a. ______________________________

   b. ______________________________

2. Label the correct and incorrect shaft assemblies shown below



a. ____________________



b. ____________________

Courtesy of John Deere and Company

3. List at least three safety precautions

   a. ______________________________

   b. ______________________________

   c. ______________________________

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE DRIVE SHAFT.

Service the drive shaft on the designated tractor.

CORRECT RESPONSES

1. a. solid
   b. telescoping
2. a. correct
   b. incorrect
3. a. Keep shafts shields in place
   b. Disconnect PTO when not in use
   c. Keep clothing away from drive shaft

DO NOT WRITE ON THIS PAGE

LAP TM–51

Student ______________________________

Date ______________________________

SERVICING THE DRIVE SHAFT
Instructor's Final Checklist

Check the student's performance in the following elements of servicing the drive shaft.

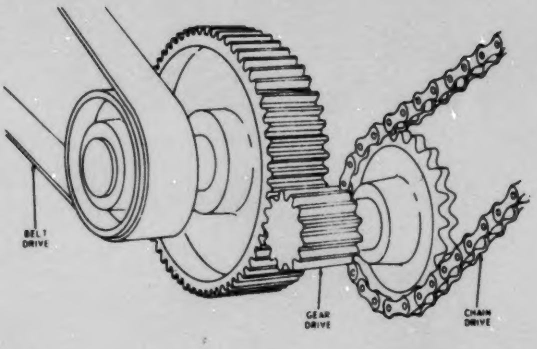
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In servicing the drive shaft, the student:

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	shut off engine and disengaged all power	[ ]	[ ]	[ ]	[ ]
2.	removed all parts necessary to reach drive shaft	[ ]	[ ]	[ ]	[ ]
3.	cleaned off all visible dirt with shop rags	[ ]	[ ]	[ ]	[ ]
4.	inspected shaft for damage	[ ]	[ ]	[ ]	[ ]
5.	lubricated all parts	[ ]	[ ]	[ ]	[ ]
6.	reassembled all parts and reengaged power	[ ]	[ ]	[ ]	[ ]
7.	checked for proper operation	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 52



Three Kinds of Drives

Servicing the Special Drives

Tractor Mechanics

Objective no. 17

Courtesy of John Deere and Company

INTRODUCTION

The type of drive used on farm tractors may vary with the manufacturer; there are three basic types other than drive shafts: (1) belt drive, (2) gear drive, and (3) chain drive. Some companies may use a combination of two or more of these drives to operate some of their equipment. You need to be familar with each of these drives and how they can be used. In this learning activity package you will learn how these drives are used, and how to service them properly.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or ,

If you need to complete learning activities in order to be able to perform this task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given service manuals for specific drives, solvents, lubricants, and the needed tools, service the special drives on the designated tractor. All parts must be clean, lubricated and adjusted to the tension specified in the manufacturer's service manual.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), Chapter 10.

(or) ______________________________

2 CHECK YOUR KNOWLEDGE of special drives by completing Student Self-Check I, UNDERSTANDING SPECIAL DRIVES.

3 READ the section on special drives in the manufacturer's service manual.

(or) The I & T Shop Manual

4 PRACTICE removing and reinstalling belts and chains from special drive-operated equipment. Follow directions listed on Instructions A, SERVICING BELT DRIVES, Instructions B, SERVICING CHAIN DRIVES, Instructions C, SERVICING GEAR DRIVES, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 6.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

solvents
lubricants
cleaning rags

SAFETY

Belts, chains and gears should be disconnected from power unit before servicing.

INSTRUCTIONS

A - SERVICING BELT DRIVES

In servicing belt drives, the following procedure should be used:

1. Check for signs of improper installation and replace or adjust if:
   - a. belt stretches beyond take-up
   - b. belt fails for no visible reason
   - c. belt is cut on bottom
   - d. belt turns over
   - e. belt creeps or slips
2. Check condition of pulleys and smooth or adjust as needed.

3. Place belt on pulley.

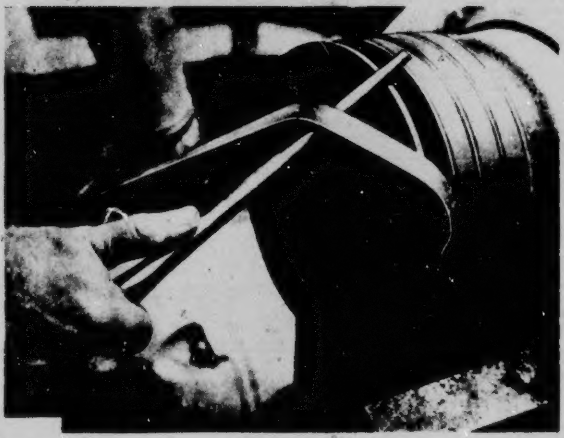


Figure 1. Never force a belt onto a pulley.

Courtesy of John Deere and Company

22

4. Check alignment.

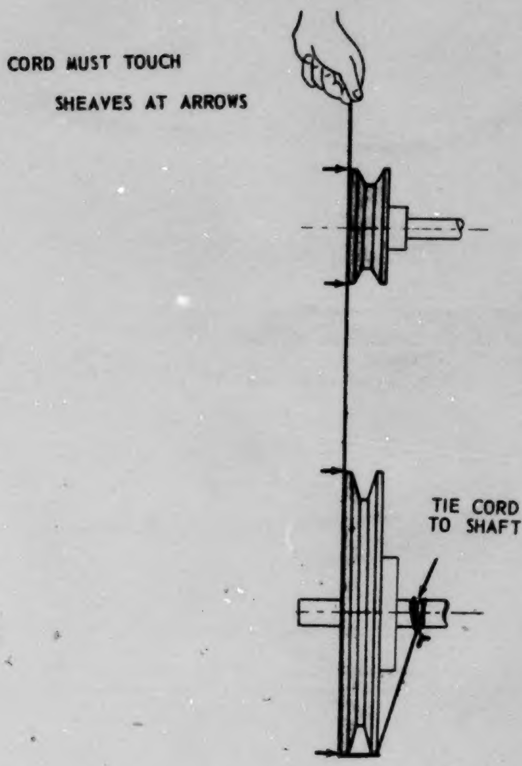

CORD MUST TOUCH
SHEAVES AT ARROWS
TIE CORD TO SHAFT

Figure 2. Checking alignment of belt pulleys.

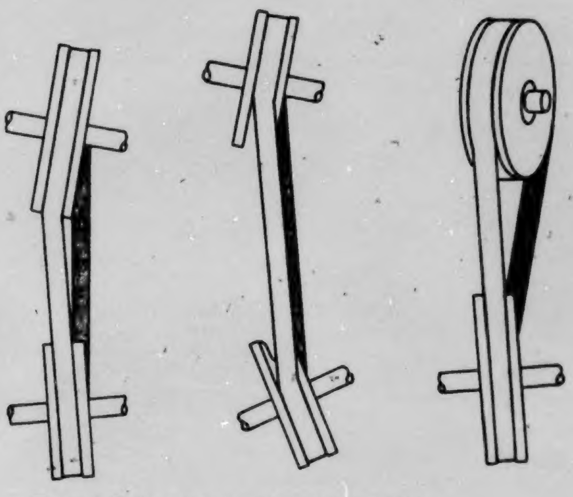


Figure 3. Pulleys not aligned can damage V-belts.

Courtesy of John Deere and Company

5. Check belt tension.

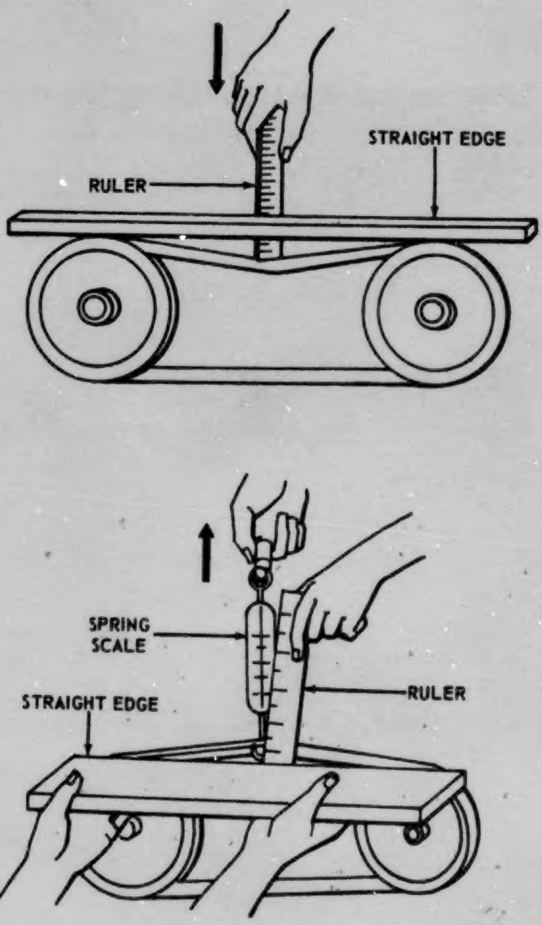
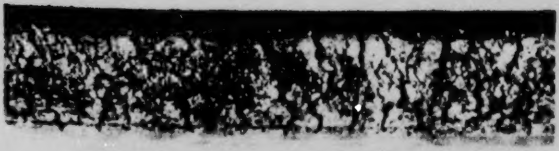

RULER
STRAIGHT EDGE
SPRING SCALE
STRAIGHT EDGE
RULER

Figure 4. Checking belt tension.

Courtesy of John Deere and Company

6. Clean belt of oil and grease with cloth and solvent. Add belt dressing if recommended by manufacturer.

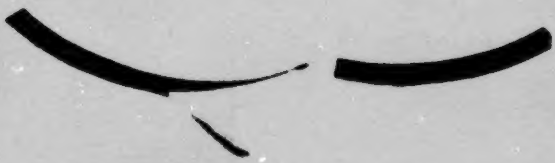
7. Clean belt shields and screens.



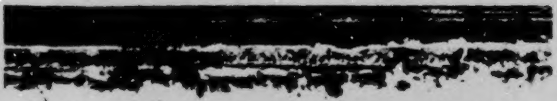
① BASE CRACKING - DAMAGED BELT

② FABRIC RUPTURE - DAMAGED BELT

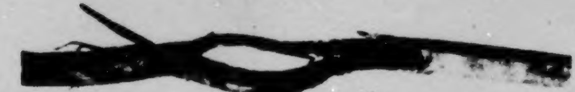
③ COVER TEAR- DAMAGED BELT



④ SLIP BURN - DAMAGED BELT



⑤ GOUGED EDGE - DAMAGED BELT



⑥ RUPTURED CORDS - DAMAGED BELT

⑦ WORN SIDES - DAMAGED BELT

Courtesy of John Deere and Company

TROUBLE SHOOTING OF V-BELT WEAR

Symptom (Fig. 61)	Cause	Remedy
1. BASE CRACKING	Normal aging. Weather rotted inner fabric.	Replace belt.
2. FABRIC RUPTURE	Prying belt onto sheave. Worn sheaves. Belt too tight.	Loosen belt tighteners before installing belt. Do not tighten belt too much. Also, replace belt.
3. COVER TEAR	Belt coming into contact with some part on machine.	Find interference and eliminate it.
4. SLIP BURN	Belt operated too loose. When operated under load, it finally grabbed and snapped.	Tighten belt properly. Also, replace belt.
5. GOUGED EDGE	Damaged sheave or interference from some part on machine.	Check condition of sheaves and check for interference. Also, replace belt.
6. RUPTURED CORDS	Driven sheave locked and drive sheave burned area of belt because belt would not rotate with sheave.	Avoid overloading drive and lubricate bearings to prevent bearing seizure. Also, replace belt.
7. WORN SIDES	Long operation without enough tension.	Check belt tension regularly and keep it properly tightened. Also, replace belt.

Figure 5 Examples of wear on V-belts

Courtesy of John Deere and Company

B-SERVICING CHAIN DRIVES

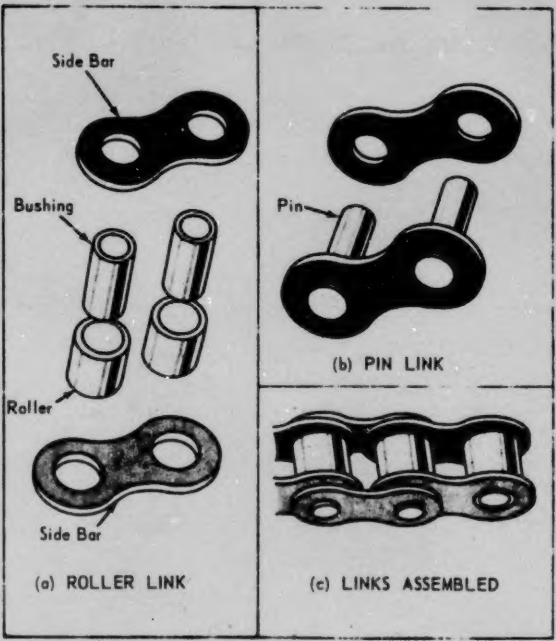
In servicing chain drives, the following procedure should be used:

1. Remove pin link and clean chain in solvent. Lubricate.

2. Clean driving sprocket, driven sprocket, and adjustable idler sprocket with brush and solvent. Lubricate.

3. With connector link removed, wrap chain around sprockets bringing free ends together on one sprocket and install connector link. Tap chain pin links back so that fasteners are snug against the connecting link plate.

4. Adjust the chain tension on adjustable idler sprocket to the manufacturer's specifications.



(a) ROLLER LINK

(b) PIN LINK

(c) LINKS ASSEMBLED

Figure 7. Roller Chain

Courtesy of John Deere and Company

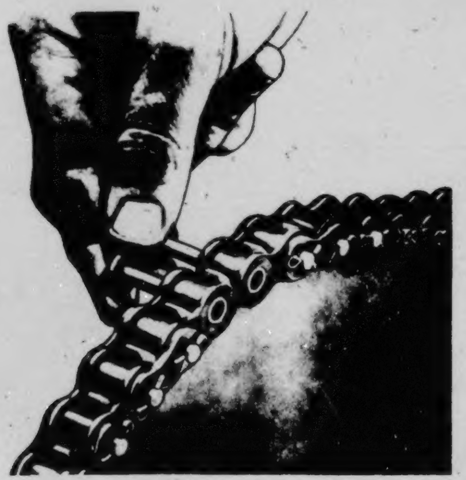


Figure 6. Installing the roller chain

Courtesy of John Deere and Company

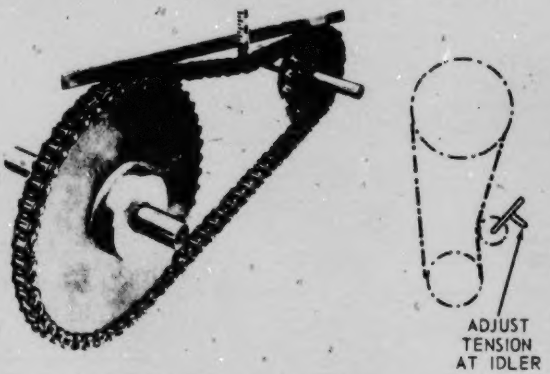
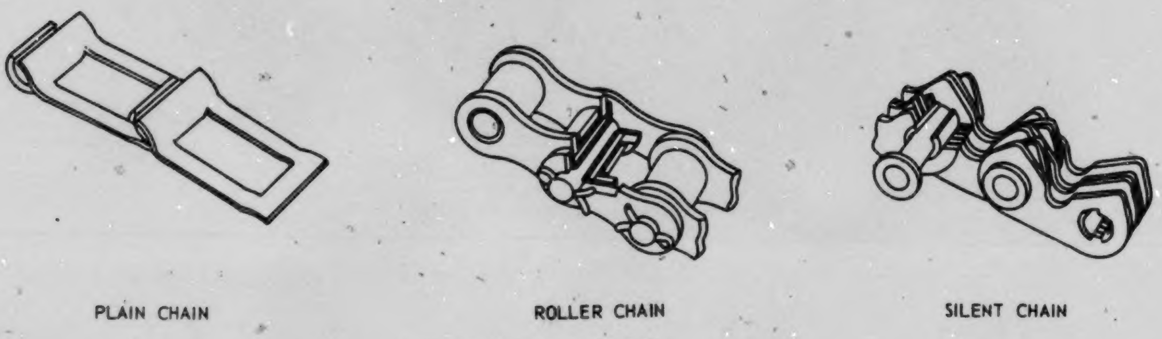


Figure 8. Checking the tension on the chain

Courtesy of John Deere and Company



PLAIN CHAIN

ROLLER CHAIN

SILENT CHAIN

Figure 9. Three types of chains

Courtesy of John Deere and Company

C SERVICING GEAR DRIVES

In servicing gear drives, the following procedure should be used:

1. Check manufacturer's service manual for type of lubricant.
2. Lubricate open gears by:
   a. replenishing lubricant in splash pan which gears run through
   b. hand lubrication using a brush or squirt can
   c. refilling the drip oiler
3. Check gears for excessive wear, breaks or cracks, and replace if necessary.

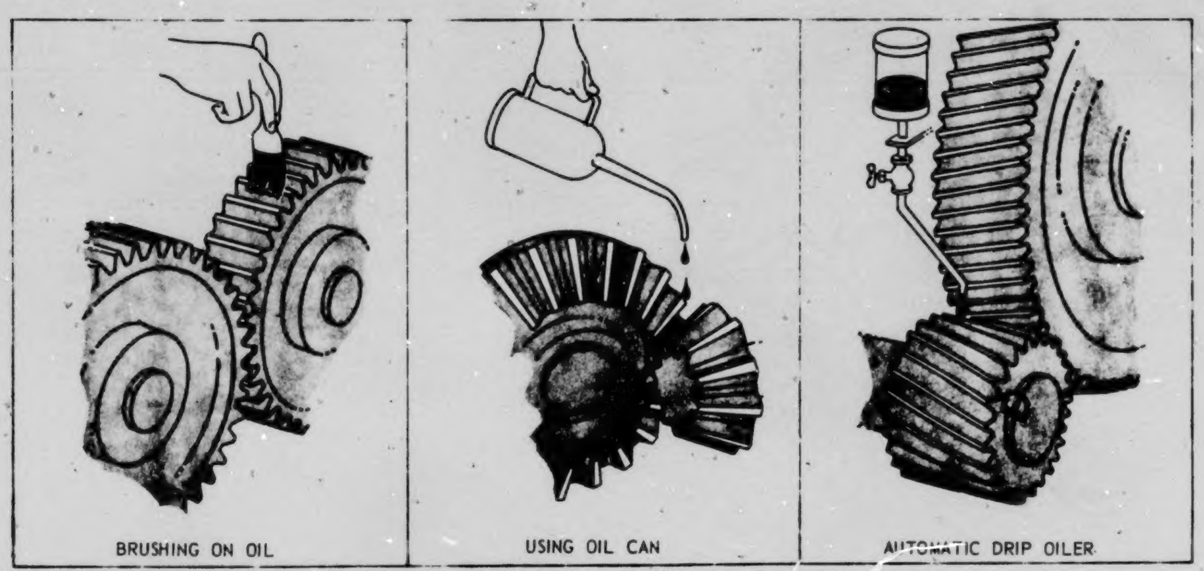
In servicing variable-speed gears, follow the instructions given here and in the manufacturer's service manual.

1. Clean.
2. Lubricate.
3. Adjust tension.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to perform in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE SPECIAL DRIVES.

Service the special drives on the designated tractor.



BRUSHING ON OIL

USING OIL CAN

AUTOMATIC DRIP OILER

Figure 10. Lubricating of open gears – three ways

Courtesy of John Deere and Company

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
UNDERSTANDING SPECIAL DRIVES

Indicate the correct response:

1. If one belt of a set of belts breaks, replace:
   a. the broken belt
   b. the broken belt and the two belts on each side
   c. all the belts in the set
   d. responses a. and b. if belts are over 6 months old

2. If you have a choice of belts from several companies, use:
   a. the cheapest belts
   b. all the belts in a set from one company
   c. a mixture to see which last longest
   d. any you feel like using

3. Belts turning over in the sheave is caused by:
   a. misalignment of sheave (pulley) and shaft
   b. worn sheave grooves
   c. improper belt tension
   d. any of the above

4. A cause of belts screeching or squealing is:
   a. improper tension
   b. belt cord damage
   c. bent shaft
   d. none of the above

5. The three types of chains are:
   a. ball and socket, roller, and trunion
   b. plain, roller, and socket
   c. plain, roller, and silent
   d. none of the above

6. The first step in installing chains is:
   a. align shaft
   b. align the sprockets
   c. install chain
   d. stretch the chain

7. The types of lubrication for chain drives are:
   a. manual
   b. drip
   c. bath or disk
   d. oil steam
   e. none of the above
   f. all of the above

8. The idler on the chain drive should be on the ______ side.
   a. top
   b. bottom
   c. left
   d. right
   e. tight
   f. slack

9. ____________ drives change rotary motion to back and forth motion.
   a. gear and sprocket
   b. crankshaft
   c. reciprocating
   d. pulley

10. Broken gear teeth are often caused by:
    a. excess backlash
    b. shock impact
    c. overloading
    d. none of the above
    e. all of the above

Compare your answers to the correct responses at the bottom of this page. Review any question you answered incorrectly before going on to the next learning activity.

CORRECT RESPONSES

1.	c	6.	a
2.	b	7.	f
3.	d	8.	f
4.	a	9.	c
5.	c	10.	e

DO NOT WRITE ON THIS PAGE

LAP TM–52

Student ______________________

Date ______________________

SERVICING THE SPECIAL DRIVES
Instructor's Final Checklist

Check the student's performance in the following elements of servicing the special drives.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the belt drive, the student:				
a. cleaned belt with solvent	☐	☐	☐	☐
b. checked condition of pulleys, replaced if needed	☐	☐	☐	☐
c. adjusted belt alignment and tension to specifications	☐	☐	☐	☐
d. cleaned shields and screens	☐	☐	☐	☐
2. In servicing the chain drive, the student:				
a. removed and cleaned chain	☐	☐	☐	☐
b. cleaned sprockets and inspected for damage	☐	☐	☐	☐
c. reinstalled chain and adjusted tension	☐	☐	☐	☐
d. checked for proper operation	☐	☐	☐	☐
3. In servicing the gear drive, the student:				
a. checked manufacturer's manual for type of lubricant	☐	☐	☐	☐
b. cleaned and lubricated all gears	☐	☐	☐	☐
c. checked condition of gears and replaced where needed	☐	☐	☐	☐

DO NOT WRITE ON THIS PAGE

LAP TM–52

Student ______________________________

Date ______________________________

SERVICING THE SPECIAL DRIVES
(Continued)
Instructor's Final Checklist

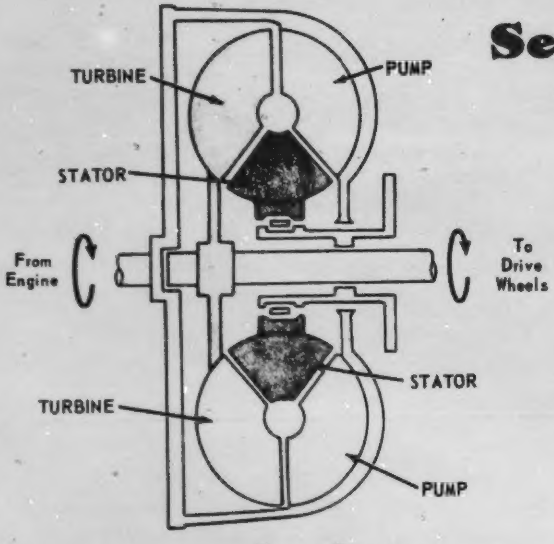
Check the student's performance in the following elements of servicing the special drives.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
d. reinstalled all gears and checked for proper operation	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 53



Torque Converter

Courtesy of John Deere and Company

Servicing Torque Converters

Tractor Mechanics

Objective nos. 4,18

INTRODUCTION

A torque converter is a fluid drive, acting as an automatic clutch and transmission to connect and disconnect power from the engine to the gear train. It operates by hydraulic force to shift very smoothly and efficiently through any speed range needed. In this learning activity package you will learn how to check torque converters for operating efficiency and repair them when necessary.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

(1) Given a mechanic's tool set, manufacturer's service manual, a pressure gauge reading 0-500 PSI, and fittings to hook the gauge to a tractor, check the torque converter with the test equipment. The gauge readings must be within 5% of the instructor's readings.

(2) Using the manufacturer's service manual, the recommended tools and testing equipment, and replacement parts, service a torque converter. Disassembly and reassembly must be in the order specified in the service manual. The entire unit should be tested and adjusted to specifications. Worn or damaged parts must be repaired or replaced, and the converter will operate to specifications.

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LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), Chapter 6, pp. 6-1 through 6-13.

(or) ____________________

2 VIEW Slides 103–116, "Torque Converters," from John Deere's series, "Power Trains."

(or) ____________________

3 CHECK YOUR KNOWLEDGE of torque converters by taking Student Self-Check I, UNDERSTANDING TORQUE CONVERTERS.

4 READ Instructions A, TESTING THE TORQUE CONVERTER, and Instructions B, SERVICING A TORQUE CONVERTER.

(or) ____________________

5 READ the section on torque converters in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

6 PRACTICE servicing a torque converter, following the directions given in Learning Activity 4 and in the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 5.

TOOLS AND EQUIPMENT NEEDED

Mechanics's tool kit
Pressure gauge (0-500 PSI)
Fitting for gauge

MATERIALS AND SUPPLIES NEEDED

Replacement parts for torque converter

SAFETY

Make sure the tractor is secure when removing the torque converter.

INSTRUCTIONS

A–TESTING THE TORQUE CONVERTER

In testing the torque converter, the following procedure should be used:

(Note: The following steps for checking a torque converter are given for a Case 530 with a twin-disc converter. The checks on other converters are much the same except for checking location differences.)

1. Check operator's manual for correct pressures and checking points.

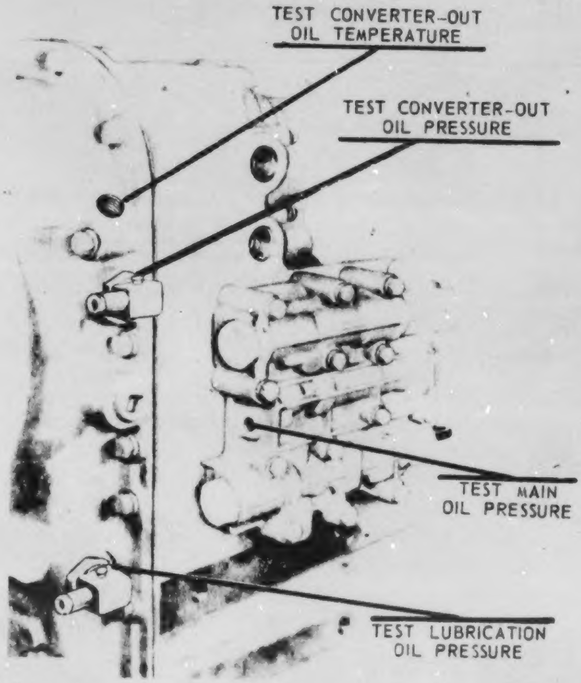
TEST CONVERTER-OUT OIL TEMPERATURE
TEST CONVERTER-OUT OIL PRESSURE
TEST MAIN OIL PRESSURE
TEST LUBRICATION OIL PRESSURE

Figure 1. Pressure and Temperature Check Points On a Typical Torque Converter Transmission

Courtesy of John Deere and Company

2. Start engine and bring transmission oil temperature up to normal operating range.

3. Depress pressure-release pedal; pressure on dash should drop to zero.

(Note: If difficulty is encountered, the clutches are not releasing or linkage is adjusting incorrectly. If customer complaint is lack of power, a pressure check is indicated.)

4. Check main pressure by removing the torque converter filter to oil cooler line, and install a 500 PSI test gauge.

5. Run engine just long enough to read pressure; then shut down engine. Compare reading with specifications given by manufacturer. Reconnect line after removing gauge.

6. If reading is within specifications, remove the plate for checking the clutch pressure and install gauge there.

7. Run tractor, and release foot lever. Compare this reading with manufacturer's specifications.

8. Pull direct-drive lever and check pressure. Pressure should drop momentarily and then return to former position.

9. Check control linkages. If the results of any of these tests do not meet specifications, or the source of the problem is not found through these tests, the torque converter will have to be replaced.

B-SERVICING A TORQUE CONVERTER

In servicing a torque converter, the following procedure should be used:

1. Follow instructions in the manufacturer's service manual to remove all parts necessary to reach the torque converter.

2. Check the fluid level and adjust to correct level if necessary.

3. Start and warm the engine and transmission to operating temperature.

4. Shift into each gear and run engine in each gear for 15–20 seconds, checking the selector valve and detent positions against the position on the shift indicator, if there is one.

5. Check actual oil levels against service manual recommendations and adjust if needed.

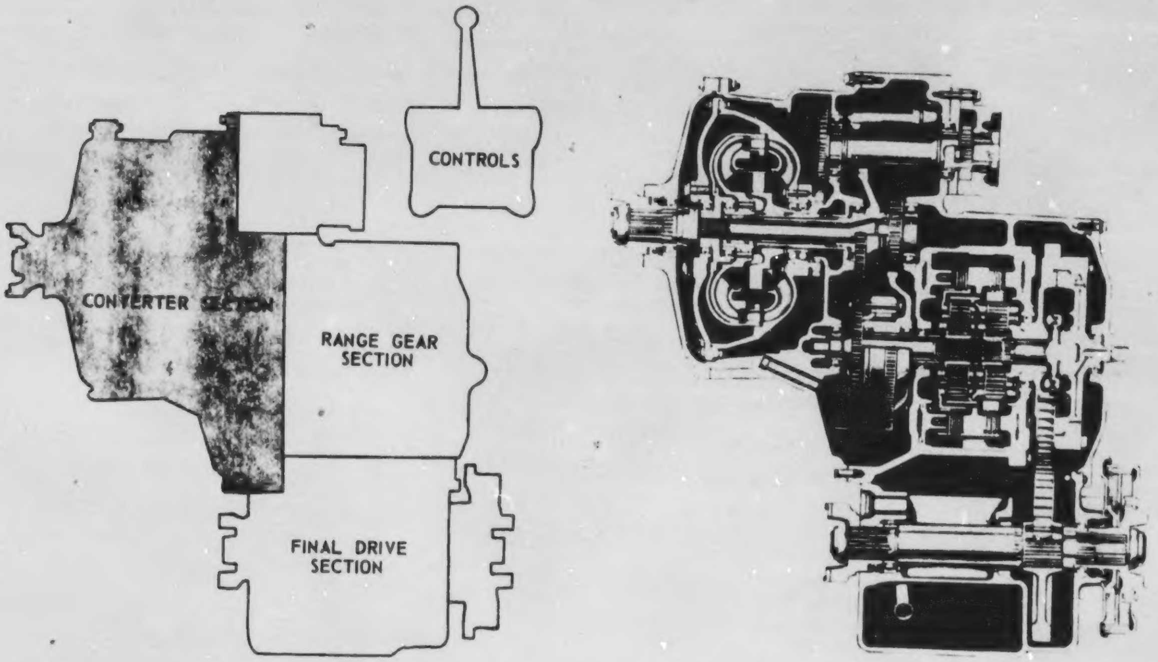

Figure 2. A complete Torque Converter transmission

Courtesy of John Deere and Company

6. When starting, running, and stopping, check the gauges for pressure and temperature. Make adjustments if necessary.

7. Check for leaks, crimped oil lines, and clogged filters; repair or replace if needed.

8. Examine the oil for water, dirt, or particles.

9. Listen for grinding or grating sounds and squealing sounds from a stuck valve. Locate source if need be, and make corrections.

10. Check for the odor of overheating oil and if present, check for:

    a. Air in the fluid system. Expel.
    b. Plugged cooler core, low coolant level, and defective water pump in the water-cooled systems. Correct.
    c. Low fluid level, clogged filter, excessive leaking past converter seals, restriction in oil line or defective oil pump. Repair or replace.
    d. Slipping clutches in the planetary gear sets. Repair or replace.
    e. Worn edges and pits on vanes of pumps, stator or turbines. Repair or replace.

11. Check out entire unit with checking tools recommended by the manufacturer. Make necessary adjustments, repairs, and/or replacements.

12. Reassemble all parts according to instructions in the service manual.

STUDENT SELF CHECK

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UNDERSTANDING TORQUE CONVERTERS

Answer the following:

1. A torque converter operates with __________________ pressure and ______________ velocity.

2. A hydrostatic drive operates with __________________ pressure and ______________ velocity.

3. A ______________ ______________ transmits torque.

4. A ______________ ______________ multiplies the torque it receives.

5. Only one turbine can be used in a single torque converter. (T or F)

6. Oil ____________ in a torque converter lubricates and cools.

7. Oil ____________ in a torque converter drives the turbine.

8. Oil ____________ in a torque converter engages the planetary gears.

9. The torque converter allows ____________ speed ranges.

10. Overheating can be a cause of problems or a symptom of problems. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any questions which you answered incorrectly before going on to the next learning activity.

CORRECT RESPONSES

1. low, high
2. high, low
3. fluid coupling
4. torque converter
5. False
6. flow
7. velocity
8. pressure
9. infinite
10. True

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING TORQUE CONVERTERS.

Check the torque converter with test equipment specified for the designated tractor.

Service a torque converter on the designated tractor.

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LAP TM-53

Student ______________________

Date ______________________

SERVICING TORQUE CONVERTERS

Instructor's Final Checklist

Check the student's performance in the following elements of servicing torque converters.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In testing the torque converter, the student:					
1.	Consulted manufacturer's service manual for correct pressure and checking points	[ ]	[ ]	[ ]	[ ]
2.	Started engine and brought engine temperature to normal operating range	[ ]	[ ]	[ ]	[ ]
3.	Secured pressure reading at all checking points within 5% of those by the instructor	[ ]	[ ]	[ ]	[ ]
4.	Checked control linkage	[ ]	[ ]	[ ]	[ ]
In servicing the torque converter, the student:					
1.	Removed all parts necessary to reach torque converter, following directions in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
2.	Checked and adjusted fluid level	[ ]	[ ]	[ ]	[ ]
3.	Started engine and brought engine and transmission to normal operating temperature	[ ]	[ ]	[ ]	[ ]
4.	Ran tractor in each gear for 20 seconds and checked for proper operation	[ ]	[ ]	[ ]	[ ]
5.	Checked gauges for pressure and temperature readings	[ ]	[ ]	[ ]	[ ]
6.	Checked for leaks, crimped oil lines, and clogged filters	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–53

Student ____________________

Date ____________________

SERVICING TORQUE CONVERTERS

(Continued)

Instructor's Final Checklist

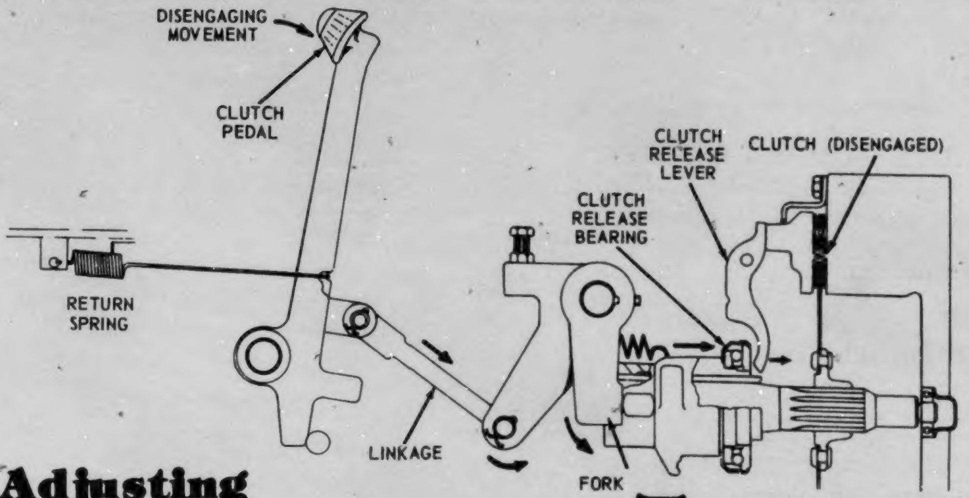
Check the student's performance in the following elements of servicing torque converters.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
7. Located source of all grinding and grating sounds and made corrections	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 54



Adjusting Clutch Free Play

Tractor Mechanics

Objective no. 137

INTRODUCTION

A clutch will operate for several hundred hours without adjustment unless the tractor driver has been "riding" the clutch pedal. Some drivers have developed the habit of resting their foot on the clutch pedal. This will cause the clutch to start slipping very quickly. Once the clutch starts to slip, it will wear out rapidly unless adjustment is made. In this package you will learn how to adjust the clutch pedal according to specifications, thus preventing damage to the clutch plate.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3. Then either arrange with your instructor to complete the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the clutch on the designated tractor, the manufacturer's service manual, a ruler, and the right size open-end wrench, adjust the clutch free play. The adjustment will be made to manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Tractor Maintenance: Principles and Procedures* (AAVIM), pp. 83 through 87.

(or) ________________

2 READ *Fundamentals of Service: Power Trains* (John Deere & Company), Chapter 2, pages 5, 11, 12, and 13.

(or) ________________

3 VIEW slide-tape presentation TM-54 "Adjusting Clutch Free Play."

(or) ________________

4 CHECK YOUR KNOWLEDGE by completing Student Self-Check I, UNDERSTANDING CLUTCH ADJUSTMENT.

5 STUDY the section on clutches in the manufacturer's service manual.

6 PRACTICE adjusting the clutch free play. Follow the directions on Instruction Sheet I, ADJUSTING CLUTCH FREE PLAY, and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity listed on page 3.

TOOLS AND EQUIPMENT NEEDED

Manufacturer's Service Manual
Ruler
Mechanic's Tool Set

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

Do not start the tractor while it is being worked on.

INSTRUCTIONS

ADJUSTING CLUTCH FREE PLAY

To adjust the free play in a clutch, the following procedure should be used:

1. Measure the amount of free play in the clutch pedal arm and compare to specifications in the manufacturer's service manual.

2. Loosen nuts on the adjusting yoke located at the lower end of the clutch operating rod. Adjust free play to specifications and tighten nuts.

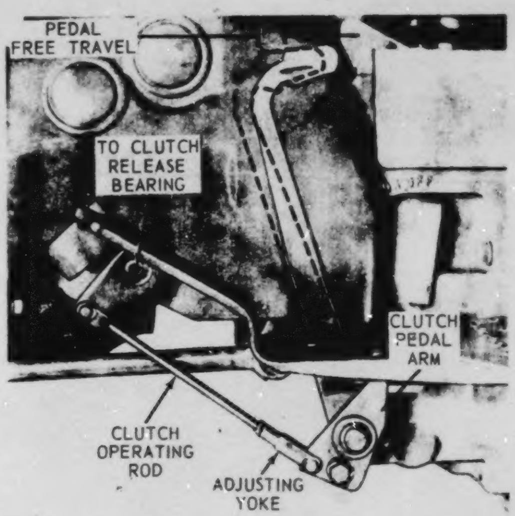


Figure 1. Clutch pedal freeplay adjustment.

Courtesy of John Deere and Company

STUDENT SELF CHECK

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UNDERSTANDING CLUTCH ADJUSTMENT

1. Why is free play necessary in a typical tractor clutch?

2. When the clutch is engaged, power is being delivered from the engine to the transmission.

   True_____ False_____

3. A hydraulic clutch control does not require any free play.

   True_____ False_____

4. All tractor clutches are single-disc dry clutches.

   True_____ False_____

5. Hand clutches are adjusted at the factory and do not require further adjustments.

   True_____ False_____

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. To prevent clutch slippage and excessive wear of the clutch release bearing
2. True
3. False
4. False
5. False

CHECK-OUT ACTIVITY LAP 54

The statement below explains the activity you must be able to complete in order to finish this package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING CLUTCH FREE PLAY.

Adjust the clutch free-play on the designated tractor

DO NOT WRITE ON THIS PAGE

LAP 54

Student ____________________

Date ____________________

ADJUSTING CLUTCH FREE PLAY

Instructor's Final Checklist

Check the student's performance in the following elements of adjusting clutch free play.

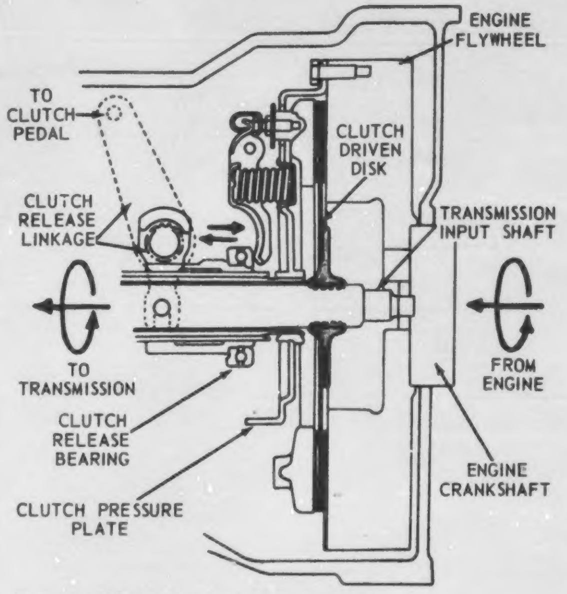
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In adjusting clutch free play, the student:

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	Checked manufacturer's service manual for clearances	☐	☐	☐	☐
2.	Measured the amount of free play in the clutch pedal and compared to manufacturer's service manual	☐	☐	☐	☐
3.	Adjusted clutch to specifications and tightened nuts	☐	☐	☐	☐
4.	Checked for proper operation	☐	☐	☐	☐

Learning Activity Package Number 55


ENGINE FLYWHEEL
TO CLUTCH PEDAL
CLUTCH DRIVEN DISK
CLUTCH RELEASE LINKAGE
TRANSMISSION INPUT SHAFT
TO TRANSMISSION
FROM ENGINE
CLUTCH RELEASE BEARING
ENGINE CRANKSHAFT
CLUTCH PRESSURE PLATE

Courtesy of John Deere and Company

Servicing a Dry Clutch

Tractor Mechanics

Objective no. 138

INTRODUCTION

The clutch on your tractor will seldom give trouble if it is used properly and serviced regularly. Repairing or replacing the clutch is a major job. It should not be undertaken unless the proper safety equipment is available. Where such equipment is available, repairing the clutch becomes just another job, requiring patience and hard work. In this learning activity package you will learn how to remove, service, and replace a dry clutch in a tractor.

DIRECTIONS

Before you begin this learning activity package, you should have completed Package 54, ADJUSTING CLUTCH FREE PLAY.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the manufacturer's service manual and the necessary tools and replacement parts, service a dry clutch. When servicing is complete, the clutch must operate according to manufacturer's specifications, and there should not be excessive lubrication of the bearings or release fork.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), Chapter 2, "Clutches."

(or) ______________________________

2 CHECK YOUR KNOWLEDGE of trouble-shooting procedure for clutches by taking the Student Self-Check I, DIAGNOSING PROBLEMS IN CLUTCHES.

3 STUDY the section on clutch repair in the manufacturer's service manual.

(or) The I & T Shop Manual

4 PRACTICE removing and servicing the clutch on the designated tractor. Follow the procedure outlined on Instructions A, SEPARATING THE TRACTOR, Instructions B, SERVICING A DRY CLUTCH, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Hydraulic jack
Chain hoist
Engine and transmission supports
Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement parts

SAFETY

Make sure tractor engine and transmission are secured when separated for removal of clutch. Be careful not to get iron filing from chain into the eyes. Wear safety goggles.

INSTRUCTIONS

A–SEPARATING THE TRACTOR

When separating the tractor, the following procedure should be used:

1. Have available two jack stands, chain hoist, hydraulic jack, and a mechanic's tool kit.
2. Keep manufacturer's service manual nearby for quick reference.
3. Separate the tractor engine and front axle assembly from the transmission and rear axle assembly. Follow directions exactly as given in the manufacturer's service manual.
4. CAUTION: Be sure that both sections of your tractor are properly secured before beginning work on the clutch. This machine is heavy and could cause serious injury to someone if it were to fall.

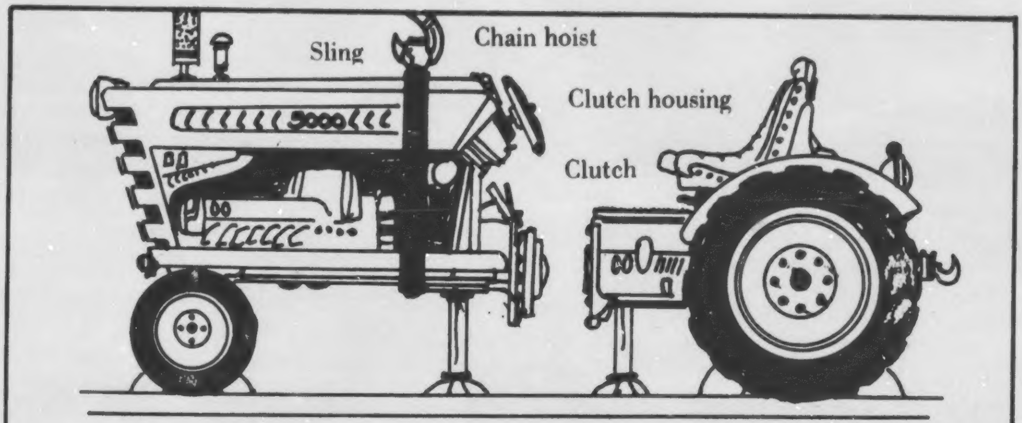


Figure 1. Separating the tractor.

B-SERVICING A DRY CLUTCH

In servicing a dry clutch the following procedure should be followed:

1. Check the manufacturer's service manual for proper equipment and procedure for specified clutch. Spring pressure must be controlled and released evenly to avoid injury.
2. Check clutch release and pressure mechanisms (pressure should be even around the clutch).
3. Adjust release levers so that contact with release bearing will be uniform and the pressure plate will release evenly.
4. Examine clutch and rebuild, if necessary, following instructions in the service manual.
5. Check clutch for free play.
6. Lubricate the pilot bearing, release bearing and release fork sparingly.
7. Make clutch release adjustment following instructions in the service manual.

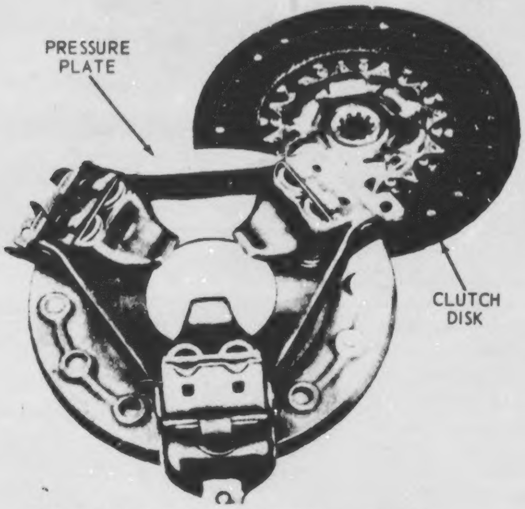


Figure 2. Dry-type clutch disk and pressure plate.

Courtesy of John Deere and Company

DO NOT WRITE ON THIS PAGE!

DIAGNOSING PROBLEMS IN CLUTCHES

1. List as many causes for each of the following clutch troubles as possible.
   a. chattering
   b. dragging
   c. squeaks
   d. rattles
   e. grabbing
   f. slipping
   g. vibrating
   h. failure

Compare your answers with the correct response in the reference *Fundamentals of Service: Power Trains*, pp. 2-17 and 2-18. If you were not able to list at least two items in each category or if you missed any items, review the material before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A DRY CLUTCH.

Service the dry clutch on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–55

Student ______________________

Date ______________________

SERVICING A DRY CLUTCH

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a dry clutch.

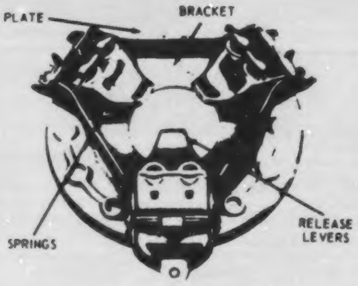
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In separating the tractor, the student:				
a. followed directions given in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
b. secured and braced both sections before servicing the clutch	[ ]	[ ]	[ ]	[ ]
2. In servicing the dry clutch, the student:				
a. checked the manufacturer's service manual for proper procedures	[ ]	[ ]	[ ]	[ ]
b. removed and inspected the clutch	[ ]	[ ]	[ ]	[ ]
c. rebuilt the clutch if needed	[ ]	[ ]	[ ]	[ ]
d. correctly reinstalled the clutch	[ ]	[ ]	[ ]	[ ]
e. lubricated all points as recommended in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
f. correctly reassembled the tractor	[ ]	[ ]	[ ]	[ ]
g. checked for proper operation	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 56

SERVICING
A
WET
CLUTCH



Courtesy of John Deere and Company

Tractor Mechanics

Objective no. 142

INTRODUCTION

Farm tractors use two types of disk clutches: (1) dry-type, and (2) wet-type. They are similar except for the cooling method. The wet-type clutch is usually found on large, expensive, power units. The wet clutch in a tractor will give very little trouble when it has been used properly and serviced regularly. Repairing the clutch is a major job and should not be attempted unless the proper safety equipment is available. However, when safety equipment is available, clutch repair becomes just another job, requiring patience and hard work. In this learning activity package you will learn how to repair a wet-type clutch.

DIRECTIONS

Before beginning this learning activity package, you should have completed Package 54, ADJUSTING CLUTCH FREE PLAY.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the manufacturer's service manual, new seals, the specified oil and the necessary tools, service a wet clutch. Upon completion there must be no leaks and the oil level must be to specifications.

LEARNING ACTIVITIES

1. READ *Fundamentals of Service: Power Trains,* (John Deere Company), Chapter 2, "Clutches", pp. 2-6, 2-17 to 2-19.

   (or) ______________________________

2 CHECK YOUR KNOWLEDGE of trouble-shooting procedures for clutches by taking Student Self-Check I, TROUBLE-SHOOTING THE CLUTCH.

3 STUDY the section on clutches in the manufacturer's service manual.

   (or) The I & T Shop Manual

4 PRACTICE removing and servicing the wet clutch on the designated tractor. Follow the procedure outlined on Instructions A, SEPARATING THE TRACTOR, Instructions B, SERVICING A WET CLUTCH, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Chain hoist
Hydraulic jack
Jack stands

MATERIALS AND SUPPLIES NEEDED

Recommended oil

SAFETY

Make sure tractor parts are secure when the engine is separated from the transmission.
Be careful not to get iron filings from the chain hoist in the eyes.

INSTRUCTIONS

A-SEPARATING THE TRACTOR

When separating the tractor the following procedure should be used:

1. Have available jack stands, chain hoist, hydraulic jack, and mechanic's tool kit.
2. Keep manufacturer's service manual nearby for quick reference.
3. Separate the tractor engine and front axle assembly from the transmission and rear axle assembly. Follow the directions exactly as given in the manufacturer's service manual.

(CAUTION: Be sure both sections of the tractor are properly braced, by using jack stands and a chain hoist, before beginning work on the clutch.)

INSTRUCTIONS

B-SERVICING A WET CLUTCH

In servicing a wet clutch the following procedure should be followed:

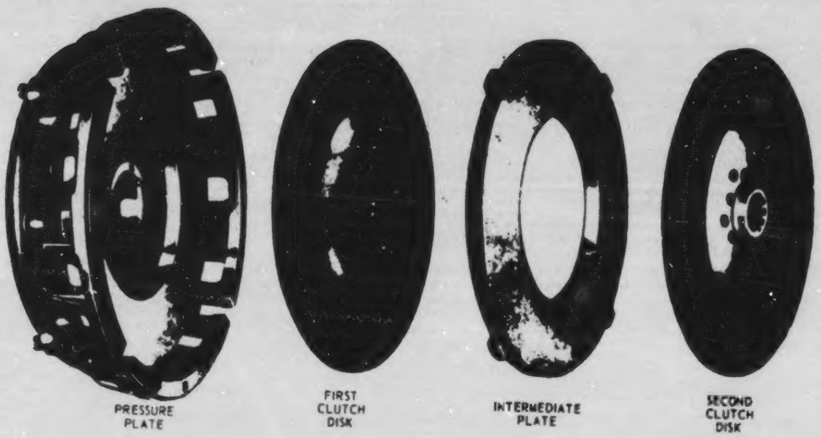
1. Check oil level and look for traces of oil leakage.
2. Disassemble, following directions in the manufacturer's service manual. Check to see if:

   a. oil circulates properly,

   b. lines are clogged on units equipped with pumps,

   c. inlet lines or filter are dirty.

   Correct problem if indicated.


PRESSURE PLATE
FIRST CLUTCH DISK
INTERMEDIATE PLATE
SECOND CLUTCH DISK

Courtesy of John Deere and Company

Figure 1. The wet-type disk clutch operates in an oil bath. Operation is similar to the dry-type clutch. Wet clutches have two disks.

3. Check (and replace as needed) the oil seals located at the clutch release fork, flywheel, and clutch shaft-end of the housing.
4. Reassemble clutch parts.
5. Check type and grade of oil specified by manufacturer, and add oil if necessary.

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
TROUBLE-SHOOTING THE CLUTCH

1. List all the probable causes you can think of for each of the following conditions in the clutch.
    a. chattering
    b. dragging
    c. squeaks
    d. rattles
    e. grabbing
    f. slipping
    g. vibration
    h. complete failure

Compare your answers with the correct responses found in the reference *Fundamentals of Service: Power Trains*, pp. 2-17 and 2-18. Review any incorrect or incomplete answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A WET CLUTCH.

Service the wet clutch on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–56

Student ____________________

Date ____________________

SERVICING A WET CLUTCH
Instructor's Final Checklist

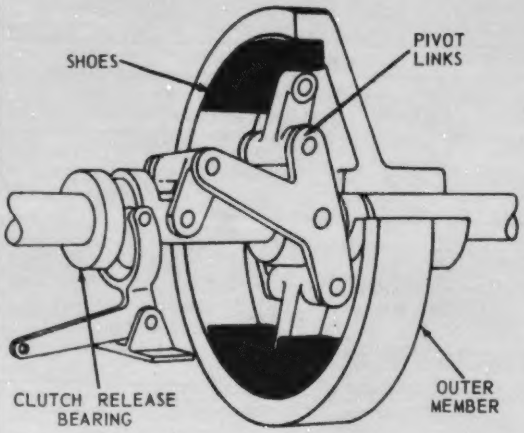
Check the student's performance in the following elements of servicing a wet clutch.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing the wet clutch, the student:				
1. separated the tractor and secured it properly	☐	☐	☐	☐
2. removed and disassembled the clutch	☐	☐	☐	☐
3. checked the oil level and looked for leaks	☐	☐	☐	☐
4. cleaned or replaced the lines and filters	☐	☐	☐	☐
5. checked (and replaced where needed) oil seals at following points:				
a. clutch release fork	☐	☐	☐	☐
b. flywheel	☐	☐	☐	☐
c. clutch shaft end of housing	☐	☐	☐	☐
6. reassembled the clutch	☐	☐	☐	☐
7. replaced the oil to proper level as specified in the manufacturer's service manual	☐	☐	☐	☐
8. reassembled front and rear sections of the tractor	☐	☐	☐	☐
9. checked for proper operation	☐	☐	☐	☐

Learning Activity Package Number 57



Courtesy of John Deere and Company

Servicing an Expanding Shoe Clutch

Tractor Mechanics

Objective no. 139

INTRODUCTION

Tractor clutches give very little trouble, unless they have been roughly treated. If it does become necessary to remove and repair or replace the clutch, several hours of hard work will be required. You can do a "clutch job" if you are patient and willing to follow directions. In this learning activity package you will learn how to remove, repair, or replace an expanding shoe clutch.

DIRECTIONS

Before beginning this learning activity package you should have completed Package 54, ADJUSTING CLUTCH FREE PLAY.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to learn more about expanding shoe clutches, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the service manual, solvents, lubricants, replacement parts, and the necessary tools, service an expanding shoe clutch. Disassembly to reassembly must be in the order specified by the manufacturer. All worn and damaged parts should be repaired or replaced, and the serviced clutch must function as specified.

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), Chapter 2, "Clutches," pp. 2-10 and 2-17 to 2-19.

(or) ________________________

2 CHECK YOUR KNOWLEDGE of trouble-shooting shoe clutches by taking Student Self-Check, TROUBLE-SHOOTING CLUTCHES.

3 STUDY the section on clutches in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

4 PRACTICE removing and servicing the clutch on the designated tractor. Follow the procedure outlined on Instructions, SERVICING AN EXPANDING SHOE CLUTCH, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Recommended solvent
Recommended lubricant
Replacement parts

SAFETY

No special safety precautions.

INSTRUCTIONS

SERVICING AN EXPANDING SHOE CLUTCH

Before you can service the clutch you must be able to separate the tractor. In order to do this the following procedure should be used:

1. Separate the engine and front axle assembly from the transmission and rear axle assembly. Follow the directions given in the manufacturer's service manual.
2. Brace tractor sections securely before starting work on the clutch. CAUTION: This tractor is heavy and could cause serious injury if it were to fall on someone.

In servicing the expanding shoe clutch, the following procedure should be used:

1. There are two types of expanding shoe clutches: (1) the centrifugal type, and (2) the mechanical type. Determine the clutch type and specification by reading the manufacturer's service manual for the designated tractor.

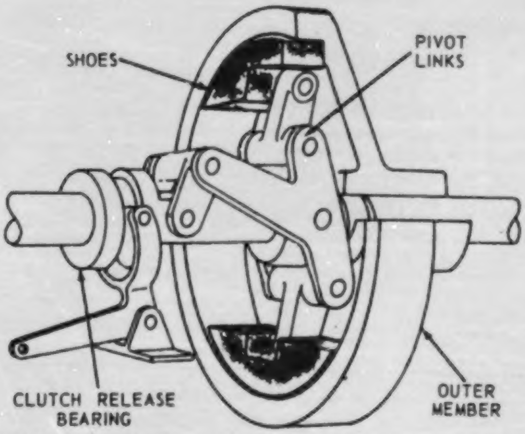


Figure 1. Expanding Shoe Clutch (Mechanical Type)

Courtesy of John Deere and Company

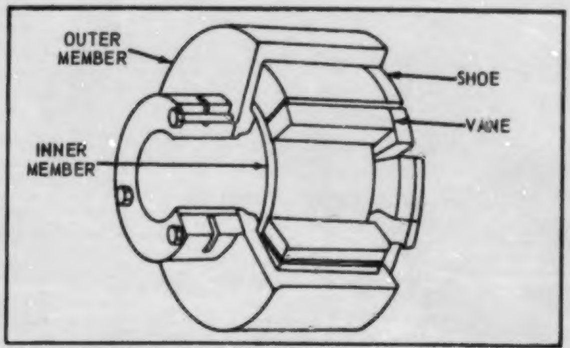


Figure 2. Expanding Shoe Clutch (Centrifugal Type)

Courtesy of John Deere and Company

2. Remove all parts necessary to reach clutch following instructions in the service manual.

3. Check, repair or replace where indicated:

   a. the outer member

   b. the inner member

   c. the clutch release bearing

   d. the pivot links

   e. the vanes and vane spacing (centrifugal type)

   f. the shoes

4. Clean all parts and lubricate with the recommended lubricants.

5. Reassemble according to recommendations in the service manual.

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
TROUBLE-SHOOTING CLUTCHES

1. List all the probable causes you can think of for the following problems in clutches.

   a. chattering

   b. dragging

   c. squeaking

   d. rattling

   e. slipping

   f. grabbing

   g. vibration

   h. complete failure

Compare your answers with the correct responses found in the reference *Fundamentals of Service: Power Trains*, pp. 2-17 through 2-19. There are 63 possible causes. Review your answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist. SERVICING AN EXPANDING SHOE CLUTCH.

Service an expanding shoe clutch on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–57

Student ____________________

Date ____________________

SERVICING AN EXPANDING SHOE CLUTCH

Instructor's Final Checklist

Check the student's performance in the following elements of servicing an expanding shoe clutch.

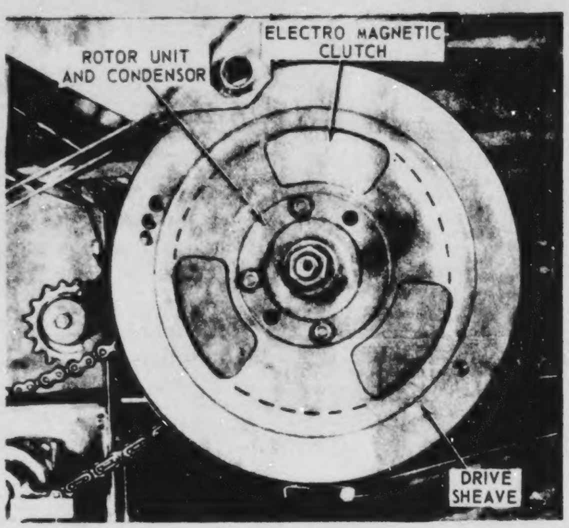
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In servicing an expanding shoe clutch, the student:

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. separated the tractor following the directions given in the manufacturer's service manual	☐	☐	☐	☐
2. checked and repaired or replaced, where indicated, each of the following:				
a. the outer member	☐	☐	☐	☐
b. the inner member	☐	☐	☐	☐
c. clutch release bearing	☐	☐	☐	☐
d. pivot links	☐	☐	☐	☐
e. the vanes and vane spacing	☐	☐	☐	☐
f. the shoes	☐	☐	☐	☐
3. cleaned and lubricated all parts with recommended lubricant	☐	☐	☐	☐
4. reassembled according to recommendations in the manufacturer's service manual	☐	☐	☐	☐
5. followed good safety precautions before attempting to do the task	☐	☐	☐	☐
6. secured satisfactory clutch performance	☐	☐	☐	☐

Learning Activity Package Number 58



Servicing a Magnetic Clutch

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 140

INTRODUCTION

Magnetic clutches are used on farm equipment when it is desirable to stop the operation of one part of the machine but keep another part operating. An example could be a combine, where it may be desirable to stop the operation of the cutter bar but keep the separating equipment working. The clutch consists of an electrical switch, coil, condenser, face plate, and rotor unit. When the switch is turned to the "on" position, a magnetic field is set up which pulls the face plate against the rotor, causing power to be transmitted to the drive mechanism. In this learning activity package you will learn how to service a magnetic clutch.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given open end wrenches, jumper wire, and a pulley puller, service a magnetic clutch, installing a new coil if necessary. Upon completion of the task, the pulley must spin without interference and the clutch must engage properly.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Electrical Systems* (John Deere Company), Chapter 7, pp. 6-8.

(or)____________________

2 CHECK YOUR KNOWLEDGE of magnetic clutches by taking Student Self-Check I, UNDERSTANDING MAGNETIC CLUTCHES.

3 READ the section on magnetic clutches in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

4 PRACTICE removing and checking the wiring, voltage and amperage, and replacing or repairing a magnetic clutch. Follow the procedure outlined in Instructions, SERVICING A MAGNETIC CLUTCH, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Jumper wire
Pulley puller

MATERIALS AND SUPPLIES NEEDED

Replacement coil

SAFETY

No special safety precautions.

INSTRUCTIONS

SERVICING A MAGNETIC CLUTCH

In servicing the magnetic clutch the following procedure should be used:

1. If clutch fails to engage when it should, run a jumper wire from the "hot" terminal of the battery to the clutch coil input. If the coil ground is satisfactory and the jumper will not energize the clutch, the coil is defective and must be replaced.

2. The pulley, clutch plate, and bearing are generally removed and replaced as a unit. This unit must be removed with an appropriate puller to gain access to the coil.

3. Remove the old coil and install the new coil in the same position (correct positioning is essential to satisfactory operation).

4. Reinstall pulley assembly.

5. Spin pulley to check for interference.

6. Check clutch for proper operation.

7. If the clutch doesn't operate properly, recheck, beginning with Step 1 and following directions given until the problem is located and corrected.

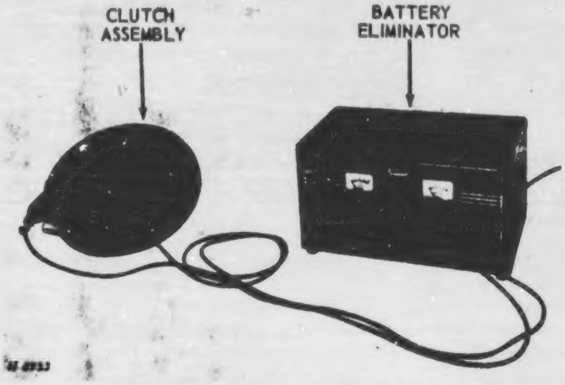


Figure 1. Checking Field Coil with Battery Eliminator

Courtesy of John Deere and Company

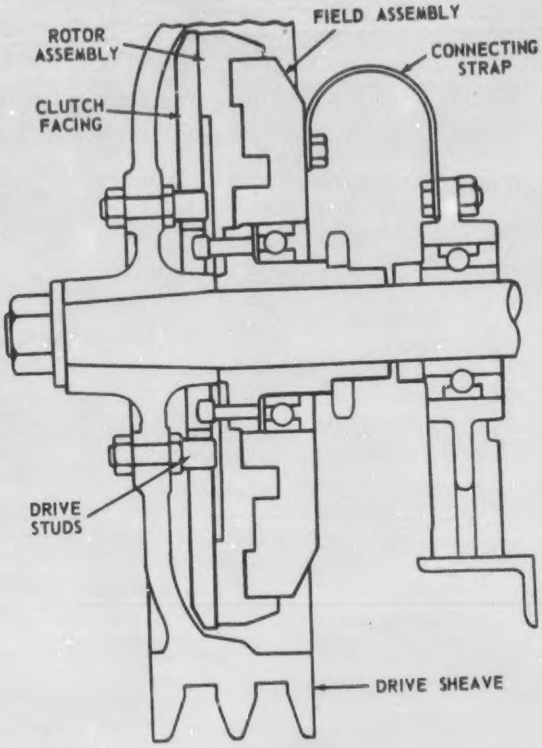

ROTOR ASSEMBLY
FIELD ASSEMBLY
CONNECTING STRAP
CLUTCH FACING
DRIVE STUDS
DRIVE SHEAVE

Figure 2. Operation of Electromagnetic Clutch

Courtesy of John Deere and Company

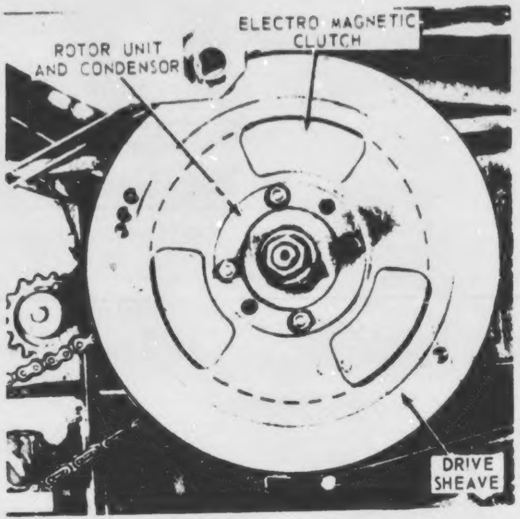

ROTOR UNIT AND CONDENSOR
ELECTRO MAGNETIC CLUTCH
DRIVE SHEAVE

Figure 3. Electromagnetic Clutch on a Grain Combine

Courtesy of John Deere and Company

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

UNDERSTANDING MAGNETIC CLUTCHES

Answer the following:

1. The magnetic clutch is an electrical device which allows operation of one part of the machine but stops another part. (True or False)

2. List the main parts of a magnetic clutch.

   a.
   b.
   c.
   d.

3. A loose wire will cause the magnetic clutch to fail. (True or False)

4. The magnetic clutch uses a ______________ to absorb the surge of high voltage when the clutch is not engaged.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. True
2. a. Field coil b. Rotor unit
   c. Condenser d. Switch
3. True
4. Condenser

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A MAGNETIC CLUTCH.

Service a magnetic clutch in the shop area.

DO NOT WRITE ON THIS PAGE

LAP TM–58

Student ____________________

Date ____________________

SERVICING A MAGNETIC CLUTCH

Instructor's Final Checklist

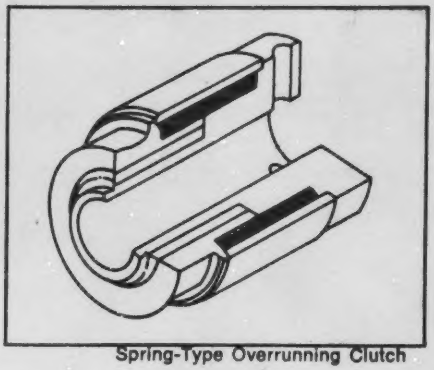
Check the student's performance in the following elements of servicing a magnetic clutch.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In servicing a magnetic clutch, the student:	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. removed parts necessary to reach the clutch for service	☐	☐	☐	☐
2. checked the condition of the coil by use of a jumper cable	☐	☐	☐	☐
3. checked all electrical connections and repaired where needed	☐	☐	☐	☐
4. checked pulley, clutch plate, and bearing; replaced if needed	☐	☐	☐	☐
5. reinstalled all parts	☐	☐	☐	☐
6. checked for proper operation and made the necessary corrections	☐	☐	☐	☐

Learning Activity Package Number 59



Spring-Type Overrunning Clutch

Servicing Overrunning Clutches

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 141

INTRODUCTION

Some types of machinery pulled and/or operated by a tractor are made to operate in one direction only. Severe damage can result if operation was attempted in the wrong direction. Overrunning clutches are used with these machines to prevent damage. An overrunning clutch engages when the drive mechanism is turning in one direction, but will "override," or disengage when the drive is turning in the opposite direction. In this learning activity package you will learn how to repair overrunning clutches.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a defective overrunning clutch, the manufacturer's service manual, testing equipment, replacement parts, and the necessary tools, service the clutch. Disassembly and reassembly must follow manufacturer's instructions and the clutch should operate to specifications. There should be no unnecessary damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), Chapter 2, pp. 7-9.

(or) ______________________________

2 CHECK YOUR KNOWLEDGE of overrunning clutches by taking Student Self-Check I, IDENTIFYING OVERRUNNING CLUTCHES.

3 READ the section on the overrunning clutch in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

4 PRACTICE servicing an overrunning clutch. Follow the procedure outlined on Instructions, SERVICING AN OVERRUNNING CLUTCH, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

TOOLS AND EQUIPMENT NEEDED

Test Equipment
Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement parts

SAFETY

No special safety precautions.

SERVICING AN OVERRUNNING CLUTCH

When servicing an overrunning clutch, the following procedure should be used:

(Note: There are three basic types of overrunning clutches: (1) roller, (2) cam or sprag, and (3) spring.)

1. Refer to manufacturer's service manual to obtain information on servicing and lubricating the specific overrunning clutch in question.
2. Test, repair, or replace damaged parts according to instructions in the service manual.
3. Reassemble clutch and test to see if it meets manufacturer's specifications. Adjust if necessary.

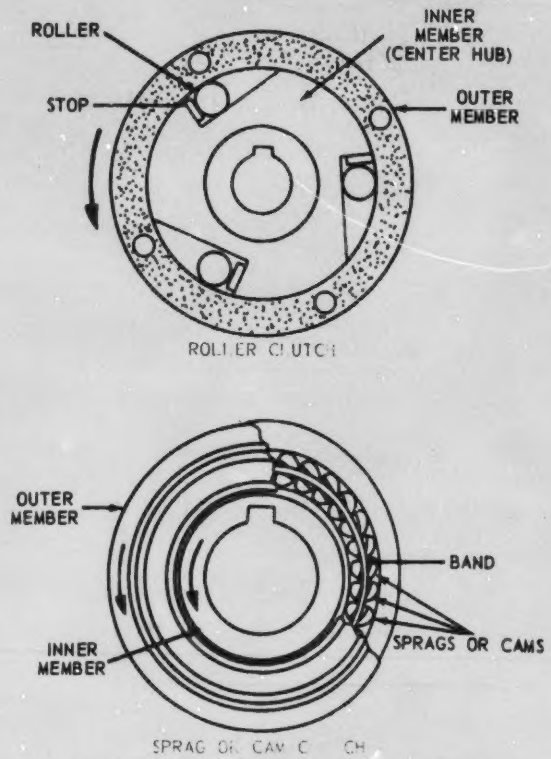

ROLLER
INNER MEMBER (CENTER HUB)
STOP
OUTER MEMBER
ROLLER CLUTCH
OUTER MEMBER
BAND
INNER MEMBER
SPRAGS OR CAMS
SPRAG OR CAM CLUTCH

Figure 1. Roller and Sprag-Type Overrunning Clutches

Courtesy of John Deere and Company

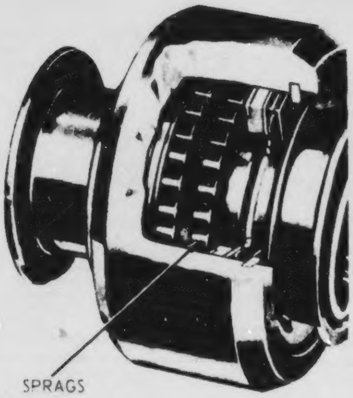


Figure 2. Sprag Type Clutch

Courtesy of John Deere and Company

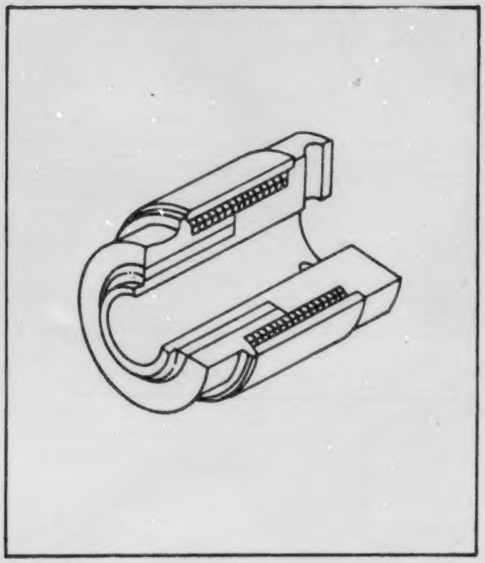


Figure 3. Spring-Type Overrunning Clutch

Courtesy of John Deere and Company

STUDENT SELF CHECK

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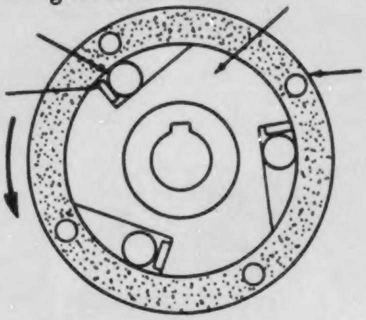
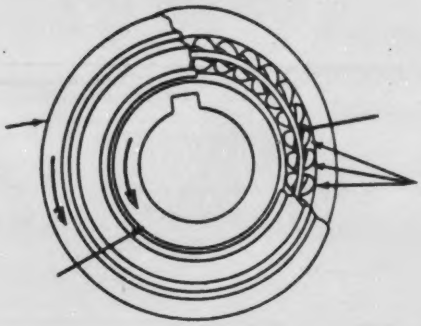
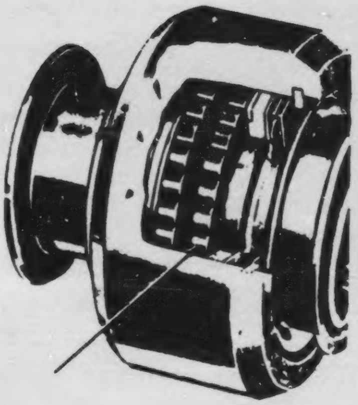
IDENTIFYING OVERRUNNING CLUTCHES

1. Identify the different types of overrunning clutches.

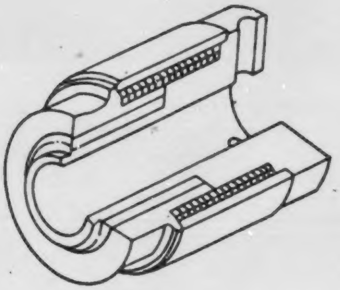






a. ______________________________

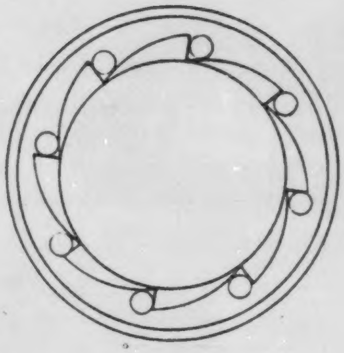
b. ______________________________

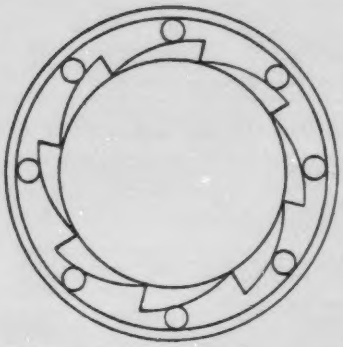


c. ______________________________

DO NOT WRITE ON THIS PAGE!

2. Which clutch below is engaged and which clutch is disengaged?





a. ____________________

b. ____________________

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. a) roller clutch b) sprag or cam clutch c) spring clutch
2. a) disengaged b) engaged

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING AN OVERRUNNING CLUTCH.

Service the designated overrunning clutch in the shop area.

DO NOT WRITE ON THIS PAGE

LAP TM–59

Student ____________________

Date ____________________

SERVICING AN OVERRUNNING CLUTCH

Instructor's Final Checklist

Check the student's performance in the following elements of servicing an overrunning clutch.

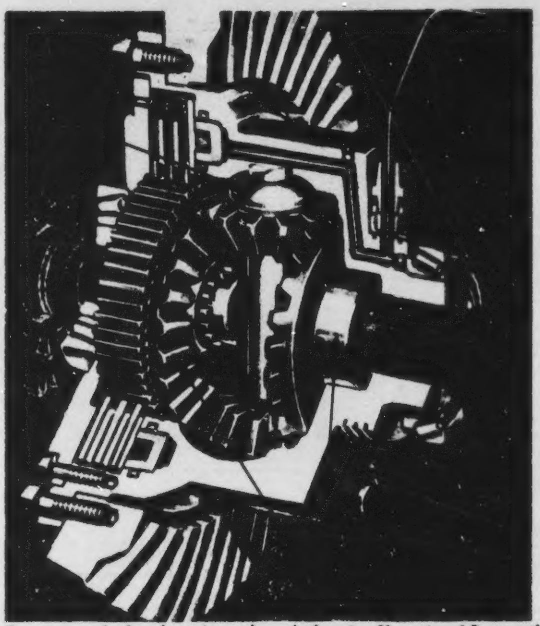
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In servicing an overrunning clutch, the student:

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. checked the manufacturer's service manual for directions	☐	☐	☐	☐
2. removed the clutch with no damage to any parts	☐	☐	☐	☐
3. tested, repaired, or replaced all damaged parts	☐	☐	☐	☐
4. tested the reassembled clutch for proper operation	☐	☐	☐	☐

Learning Activity Package Number 60



Courtesy of the American Association for Vocational Instructional Materials

Adjusting a Gear Train

Tractor Mechanics

Objective nos. 161,162,163

INTRODUCTION

The power from the engine is transferred to the differential through the gear train. In order for the maximum power to reach the differential, the gear train must be adjusted correctly. In this learning activity package you will learn how to correctly adjust the gear train of a designated tractor.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

(1) Given a gear train with too much backlash, a dial indicator, shims, the service manual and the necessary tools, measure the backlash and clearance in a gear train. Disassembly and reassembly must follow the manufacturer's instructions. The dial indicator readings must agree with the instructor's readings. Shims should be correctly installed and final adjustment must be to specifications.

(2) Given a gear shaft with too much endplay , the service manual, dial indicator, shims, and the necessary tools, measure the endplay movement in the gear shaft. Disassembly and reassembly must follow manufacturer's instructions. The dial indicator readings must agree with those of the instructor, and adjustments must be to manufacturer's specifications.

(3) Given a gear train which needs preloading, the manufacturer's service manual, shims, a dial indicator, and the necessary tools, preload the bearings in the gear train. Disassembly and

reassembly must be according to the service manual; shims should be correctly installed and adjusted. Final dial indicator readings should agree with those of the instructor and must be to manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company) pp. 1-4, 1-20 through 1-2.

(or) ______________________________

2 STUDY the power train section of the manufacturer's service manual for the designated tractor to determine break-down procedure, backlash readings specifications, end-play reading specifications, and preload specifications.

(or) The I & T Shop Manual

3 CHECK YOUR KNOWLEDGE of gear trains by taking the Student Self-Check I, ADJUSTING THE RING GEAR AND PINION.

4 READ Instructions A, MEASURING BACKLASH AND CLEARANCE IN A GEAR TRAIN; Instructions B, MEASURING END-PLAY MOVEMENT IN A GEAR SHAFT; and Instructions C, PRELOADING BEARINGS IN A GEAR TRAIN.

(or) ______________________________

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this package.

(or) ______________________________

6 PRACTICE disassembly, backlash measurement and adjustment, endplay measurement and adjustment, preload measurement and adjustment, and reassembly of gear train.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Dial indicator

MATERIALS AND SUPPLIES NEEDED

Recommended shims

SAFETY

Make sure loose clothing does not contact moving gears.

INSTRUCTIONS

A--MEASURING BACKLASH AND CLEARANCE IN A GEAR TRAIN

In measuring backlash and clearance in a gear train, the following procedure should be used:

1. Follow instructions in the manufacturer's service manual to make the gear train accessible.
2. Clean all parts.
3. Mount a dial indicator on the gear so that it registers the full rotary movement of the gear.
4. Adjust the backlash reading to specifications by using shims.
5. When the correct backlash reading is obtained, reassemble all parts according to manufacturer's instructions and specifications.

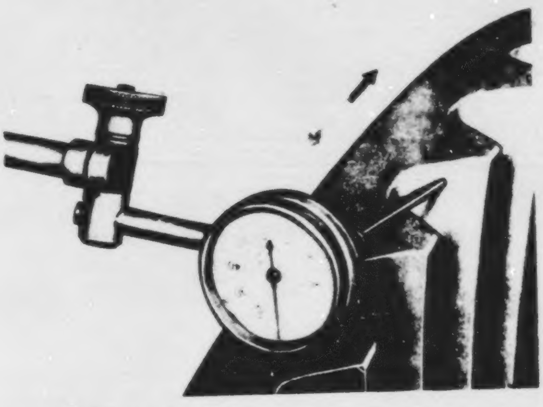


Figure 1. Checking backlash on gear.

Courtesy of John Deere and Company

B–MEASURING END-PLAY MOVEMENT IN A GEAR SHAFT

To measure the endplay movement in a gear shaft, follow this procedure:

1. Follow instructions in the manufacturer's service manual to get at gears and shaft.
2. Mount a dial indicator against the side of a gear on the end of a shaft. Then pry the gear or shaft in both directions, noting the difference between the two readings on the dial indicator.

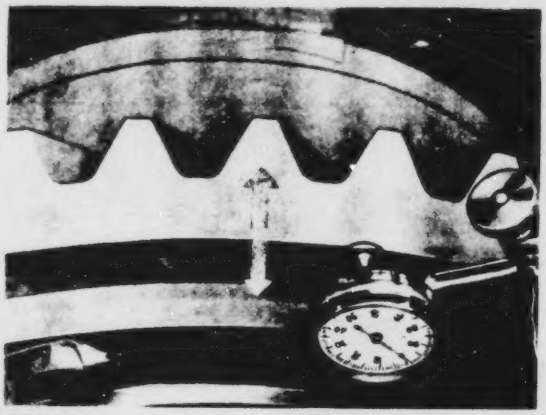


Figure 2. Checking endplay on gears and shafts.

Courtesy of John Deere and Company

3. Adjust the endplay to manufacturer's specifications with shims or adjusting nuts. (NOTE: It may be necessary to preload the gear train.)

C–PRELOADING BEARINGS IN A GEAR TRAIN

Preload must fit the design of the bearings and the strength of the parts. Check the manufacturer's service manual for the tractor you are working on. Gear trains are preloaded by thrust washers, adjusting nuts or with double-race bearing. The following instructions are for ring gear and pinion:

1. Follow instructions in the manufacturer's service manual to get at ring gear and pinion.
2. Check adjustments needed with dial indicator, following instructions in the service manual, and adjust as necessary with shims and adjusting nuts. Reassemble the gear set and adjust it to specifications.
   a. Adjust the relationship of the pinion to the ring gear with shims under the lower shaft bearing.
   b. Use shims under the upper shaft bearing to preload pinion shaft bearings. Install with extra shims, check end-play and remove the shims necessary to equal the end-play plus specified preload.
   c. Preload ring gear bearings with shims under the slide quills. Install with extra shims, check endplay and remove shims to equal the recommended endplay preload for the bearing.
   d. Transfer shims under the side quills to adjust backlash between the ring gear and pinion. Check backlash at several points around the ring gear. Transfer shims from left quill to right quill to decrease backlash, and from right to left quill to increase it.
   e. Consult manufacturer's service manual for exact steps and readings.
   f. Reassemble according to manufacturer's directions.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
ADJUSTING A GEAR TRAIN

1. Why is it not desirable to have a solid connection between the tractor drive wheels?

2. The ring gear is attached to the differential case. The case and the ring do not rotate together.

   a. true
   b. false

3. The differential pinion shaft is mounted in the case. It turns end for end with the case carrying the differential pinion gears around with it.

   a. true
   b. false

4. The differential pinion gears, being in mesh with the axle mounted side gears, turn the axles at ring gear speed.

   a, true
   b. false

CORRECT RESPONSES

1. to compensate for different wheel speed when the tractor turns or when wheel hits a bump or dip in the road surface
2. b
3. a
4. a

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING A GEAR TRAIN.

On the designated tractor, measure the backlash and clearance in the gear train.

Measure the endplay movement in the gear shaft of the power train on the designated tractor.

Preload the bearings in the gear train of the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–60

Student ______________________

Date ______________________

ADJUSTING A GEAR TRAIN

Instructor's Final Checklist

Check the student's performance in the following elements of adjusting a gear train.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In measuring the backlash and the clearance in a gear train, the student:				
a. followed the instructions in the manufacturer's service manual to reach gear train	☐	☐	☐	☐
b. cleaned all parts thoroughly	☐	☐	☐	☐
c. mounted a dial indicator on the gear so that it registered the full rotary movement of the gear	☐	☐	☐	☐
d. adjusted the backlash reading to specifications with shims	☐	☐	☐	☐
e. reassembled all parts according to manufacturer's instructions and specifications	☐	☐	☐	☐
2. The corrected backlash reading was the same as the instructor's	☐	☐	☐	☐
3. In measuring the endplay movement in a gear shaft, the student:				
a. followed instructions in the manufacturer's service manual to reach gears and shaft	☐	☐	☐	☐
b. mounted a dial indicator against the side of a gear on the end of a shaft	☐	☐	☐	☐

DO NOT WRITE ON THIS PAGE

LAP TM–60

Student ____________________

Date ____________________

ADJUSTING A GEAR TRAIN
(Continued)
Instructor's Final Checklist

Check the student's performance in the following elements of adjusting a gear train.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
c.	pried shaft or gear in both directions and recorded the difference between the two readings on the dial indicator	☐	☐	☐	☐
d.	used shims under the upper shaft bearing to preload pinion shaft bearings	☐	☐	☐	☐
e.	preloaded the gear train	☐	☐	☐	☐
f.	adjusted the endplay with shims or adjusting nuts to manufacturer's specifications	☐	☐	☐	☐
4.	In preloading the bearings in a gear train, the student:				
a.	followed instructions in the manufacturer's service manual to reach ring gear and pinion	☐	☐	☐	☐
b.	checked adjustments needed with dial indicator	☐	☐	☐	☐
c.	adjusted the relationship of the pinion to the ring gear with shims under lower shaft bearing	☐	☐	☐	☐
d.	used shims under the upper shaft bearing to preload pinion shaft bearings	☐	☐	☐	☐
e.	installed extra shims	☐	☐	☐	☐
f.	checked endplay	☐	☐	☐	☐

DO NOT WRITE ON THIS PAGE

LAP TM–60

Student ____________________

Date ____________________

ADJUSTING A GEAR TRAIN
(Continued)
Instructor's Final Checklist

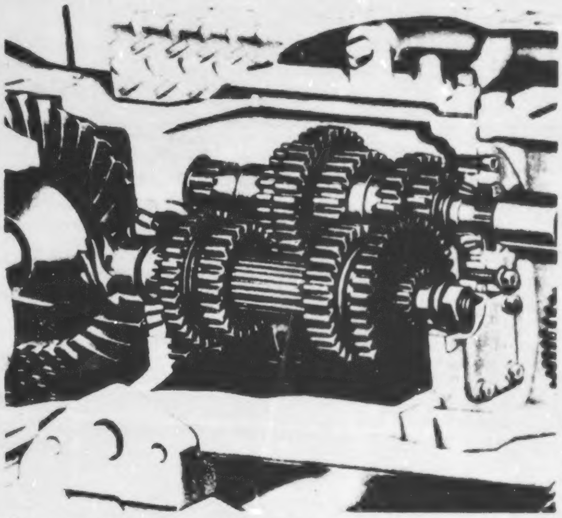
Check the student's performance in the following elements of adjusting a gear train.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
g.	removed the shims necessary to equal the endplay plus specified preload	☐	☐	☐	☐
h.	preloaded ring gear	☐	☐	☐	☐
i.	installed extra shims	☐	☐	☐	☐
j.	checked endplay	☐	☐	☐	☐
k.	removed shims to equal the recommended endplay preload for bearing	☐	☐	☐	☐
l.	transferred shims under side quills to adjust backlash between ring gear and pinion	☐	☐	☐	☐
m.	checked backlash at several points around the ring gear	☐	☐	☐	☐
n.	reassembled all parts according to manufacturer's service manual	☐	☐	☐	☐

Learning Activity Package Number 61



Courtesy of John Deere and Company

Servicing a Sliding Gear Transmission

Tractor Mechanics

Objective no. 166

INTRODUCTION

There are four basic types of tractor transmissions: (1) mechanical, (2) hydraulic-assist, (3) hydrostatic, and (4) torque converter. The mechanical transmission is the one most commonly used in farm tractors. There are three kinds of mechanical transmissions: (1) sliding-gear, (2) constant-mesh (collar shift), and (3) power shift (synchromesh). In this learning activity package you will learn how to service a sliding-gear transmission.

DIRECTIONS

Before you begin on this learning activity package, be sure you have completed Package 60, ADJUSTING A GEAR TRAIN.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the manufacturer's service manual, oil, needed replacement parts, the tools and equipment stated in the service manual, service a sliding-gear transmission. Disassembly and reassembly should follow manufacturer's instructions. All parts must be clean, and operate to manufacturer's specifications, and replacement parts must be installed where necessary.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains,* (Deere & Co.), pp. 3-1 through 3-3 and pp. 3-12 through 3-13.

(or) ____________________

2 STUDY the section on disassembly and reassembly of transmissions in the manufacturer's service manual.

(or) The I & T Shop Manual

3 CHECK YOUR KNOWLEDGE of sliding-gear transmissions by taking the Student Self-Check, SLIDING-GEAR TRANSMISSIONS.

4 OUTLINE the procedures for disassembly and reassembly of the transmission as shown in the manufacturer's service manual.

(or) ____________________

5 READ Instructions, SERVICING A SLIDING-GEAR TRANSMISSION.

(or) ____________________

6 PRACTICE servicing a sliding-gear transmission, following the procedure on Instruction Sheet I and the outline you developed in Learning Activity 3.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 6.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement parts
Transmission oil

SAFETY

Make sure tractor is secured when transmission is removed.

SERVICING A SLIDING-GEAR TRANSMISSION

There are two different types of sliding-gear transmissions. One type has the input and output shafts parallel. The other type has the input and output shafts in line. The manufacturer's service manual will confirm which type you will be servicing. The following procedure should be used:

1. Remove the transmission according to directions in the manufacturer's service manual for the designated tractor and type of transmission.

2. For general maintenance, clean all parts, and make oil change.

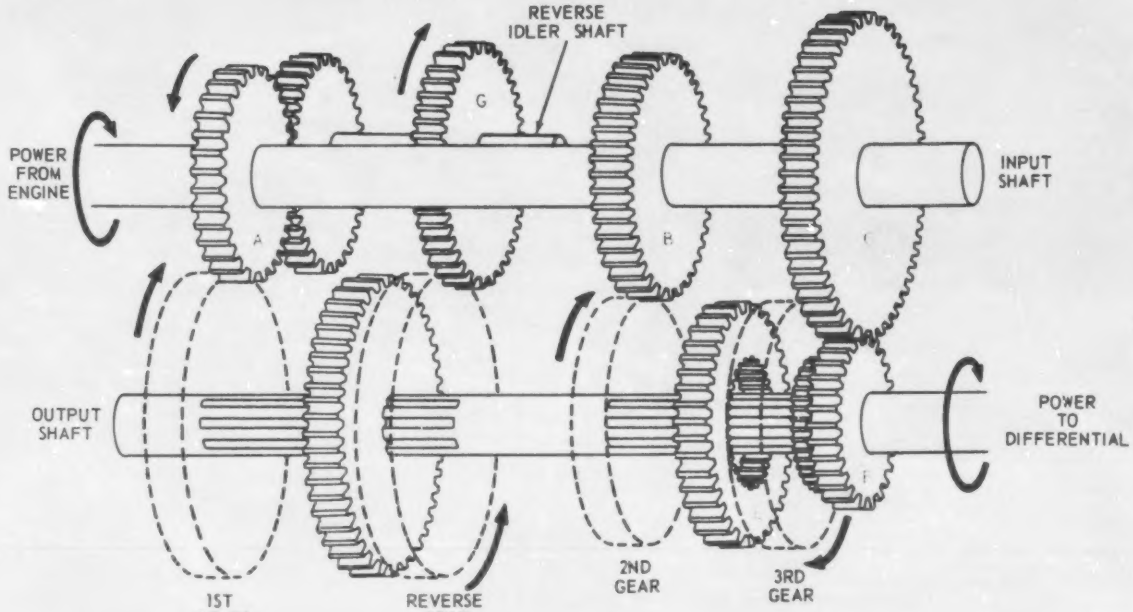

REVERSE IDLER SHAFT
G
POWER FROM ENGINE
INPUT SHAFT
A
B
C
OUTPUT SHAFT
POWER TO DIFFERENTIAL
F
1ST GEAR
REVERSE GEAR
2ND GEAR
3RD GEAR

Figure 1. Sliding gear transmission with parallel shafts.

Courtesy of John Deere and Company

3. To prevent later damages to tractor:

   a. inspect the gear teeth for excessive wear and breaks, replacing as needed.

   b. inspect for worn bearings and replace as needed.

   c. check for badly worn splines and replace if needed.

   d. check endplay in gears and shafts and adjust or replace worn parts.

   e. replace bent or worn shafts.

   f. make sure transmission is aligned with engine.

   g. replace damaged or missing gasket and transmission-case bolts.

4. Reassemble all parts, and replace transmission according to the manufacturer's instructions and specifications.

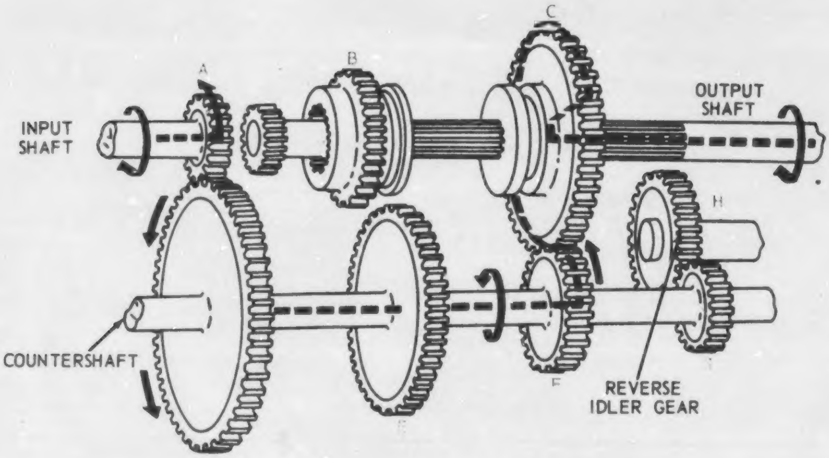


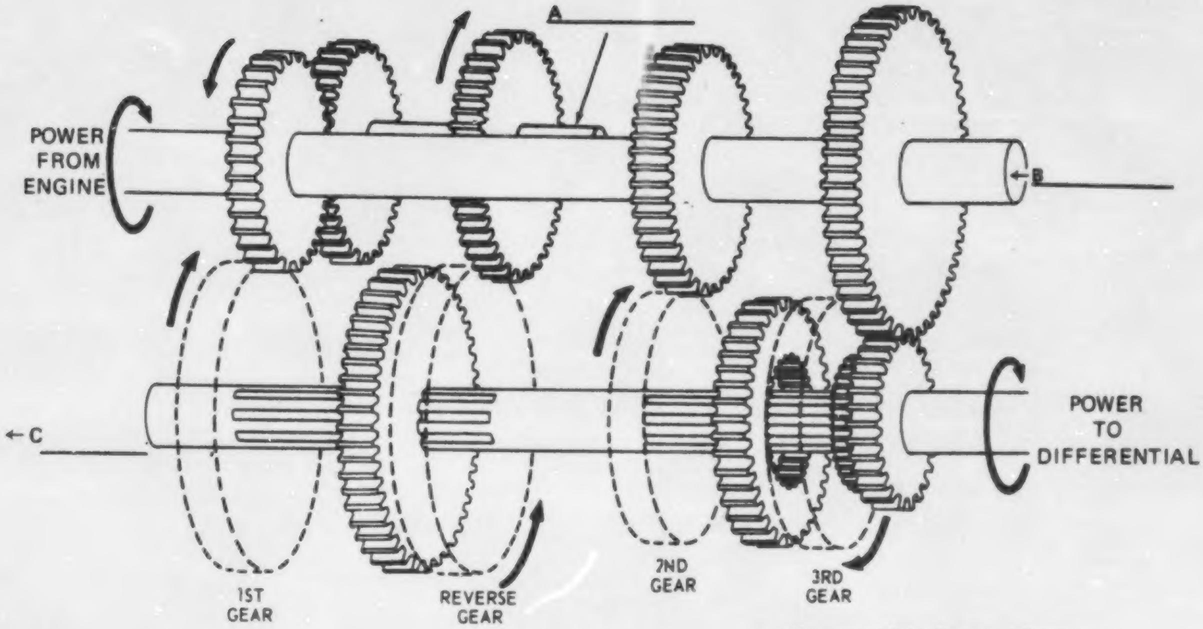
Figure 2. Sliding gear transmission with shafts in line (first gear shown)

Courtesy of John Deere and Company

75

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE !
SLIDING-GEAR TRANSMISSIONS

1. Label the three shafts in the following diagram.


A
POWER FROM ENGINE
B
← C
POWER TO DIFFERENTIAL
1ST GEAR
REVERSE GEAR
2ND GEAR
3RD GEAR

Courtesy of John Deere and Company

a. ______________________________

b. ______________________________

c. ______________________________

DO NOT WRITE ON THIS SHEET!

2. List at least three things to look for when servicing the transmission.

   a. ______________________________

   b. ______________________________

   c. ______________________________

CORRECT RESPONSES

1. a. Reverse idler shaft
   b. Input shaft
   c. Output shaft
2. a. Excessive tooth wear
   b. Broken teeth
   c. Broken detent springs or flat detent balls
   d. Damaged or clogged transmission lines
   e. Badly worn splines

CHECK-OUT ACTIVITIES LAP 61

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A SLIDING-GEAR TRANSMISSION.

Service the sliding-gear transmission on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–61

Student ____________________

Date ____________________

SERVICING A SLIDING-GEAR TRANSMISSION

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a sliding-gear transmission.

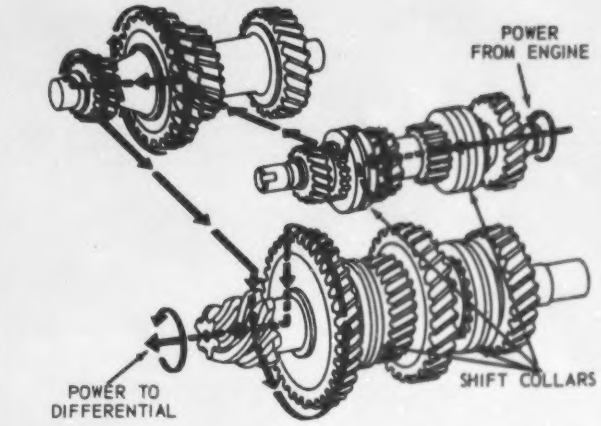
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In servicing a sliding-gear transmission, the student:

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. removed the transmission according to the directions in the manufacturer's service manual	☐	☐	☐	☐
2. cleaned all parts and made an oil change	☐	☐	☐	☐
3. checked for badly worn splines and replaced if needed	☐	☐	☐	☐
4. inspected the gear teeth for excessive wear and replaced as needed	☐	☐	☐	☐
5. inspected for worn bearings and replaced where needed	☐	☐	☐	☐
6. checked endplay in gears and shafts and adjusted or replaced as needed	☐	☐	☐	☐
7. replaced bent or worn shafts	☐	☐	☐	☐
8. checked alignment of the transmission to engine	☐	☐	☐	☐
9. replaced damaged or missing gaskets and case bolts	☐	☐	☐	☐
10. reassembled the transmission according to the manufacturer's instructions	☐	☐	☐	☐
11. replaced the transmission according to specifications	☐	☐	☐	☐

Learning Activity Package Number 62



Courtesy of John Deere and Company

Servicing a Constant Mesh Transmission

Tractor Mechanics

Objective no. 164

INTRODUCTION

The constant-mesh (collar-shift) transmission has parallel shafts with the gears in constant mesh. The transmission is shifted into operation with a control lever. Movement of this lever causes the collar shifters to engage the gears with the shafts. Because the gears are in constant mesh, and because of the complexity of the components, it is very important to provide proper service. In this learning activity package you will learn the correct procedure for servicing a constant-mesh transmission.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Package 60, "Adjusting a Gear Train," and Package 61, "Servicing a Sliding-Gear Transmission."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the necessary tools, equipment and supplies, and the manufacturer's service manual, service a constant-mesh transmission. All parts should be cleaned and reassembled correctly with no damage to any parts. The transmission should be properly torqued and lubricated and should function according to manufacturer's specifications. Disassembly and reassembly mustbe performed in the order outlined by the manufacturer and in accordance with specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), pp. 3-3 to 3-4 and 3-12 to 3-13.

(or) ______________________

2 READ Instructions, SERVICING A CONSTANT-MESH TRANSMISSION.

(or) ______________________

3 CHECK YOUR KNOWLEDGE of constant-mesh transmissions by taking the Student Self-Check, CONSTANT-MESH TRANSMISSIONS.

4 STUDY the disassembly and reassembly procedures for the transmission in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

5 OUTLINE the correct procedure for servicing the constant-mesh transmission as found in the manufacturer's service manual.

(or) ______________________

6 PRACTICE servicing a constant-mesh transmission. Follow the procedure outlined in Learning Activities 2 and 4.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Torque wrench

MATERIALS AND SUPPLIES NEEDED

Replacement bearings
Replacement collars and hubs
Recommended transmission oil

SAFETY

Make sure the tractor is secured on stands.

INSTRUCTIONS

SERVICING A CONSTANT-MESH TRANSMISSION

In servicing a constant-mesh transmission, the following procedure should be used:

1. Remove the transmission according to the instructions in the manufacturer's service manual.
2. Clean all parts of the transmission.
3. To prevent excessive wear and expense later:
    a. Inspect gear teeth for wear and replace if necessary.

Courtesy of John Deere and Company

Figure 1. Transmission Countershaft Gear. Breakdown of tooth surfaces and the concentration of pitted and spalled areas, at the edges results from excessive driveline loading during extremely severe service operation. This is associated with the housing deflection which concentrates the contact at the edge of the teeth.

    b. Inspect bearings and replace if worn.
    c. Adjust endplay in gears and shafts.
    d. Replace bent or worn shafts.
    e. Check shifter collars and hubs and replace if necessary.

4. Replace damaged or missing gaskets and case bolts.
5. Reassemble transmission according to manufacturer's instructions.
6. Reinstall transmission in tractor following instructions in manufacturer's service manual.
7. Check the alignment of the transmission to the engine.
8. Fill transmission with new oil.

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

CONSTANT-MESH TRANSMISSIONS

List at least one possible cause of each of the following conditions:

1. transmission noisy in neutral
2. transmission noisy while in gear
3. transmission hard to shift
4. gears clash when shifting
5. transmission sticks in gear
6. transmission slips out of gear
7. transmission leaks oil

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

See Power Trains – (Deere & Company) pp. 3-12 – 3-13.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A CONSTANT-MESH TRANSMISSION.

Service the constant-mesh transmission on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–62

Student ____________________

Date ____________________

SERVICING A CONSTANT-MESH TRANSMISSION

Instructor's Final Checklist

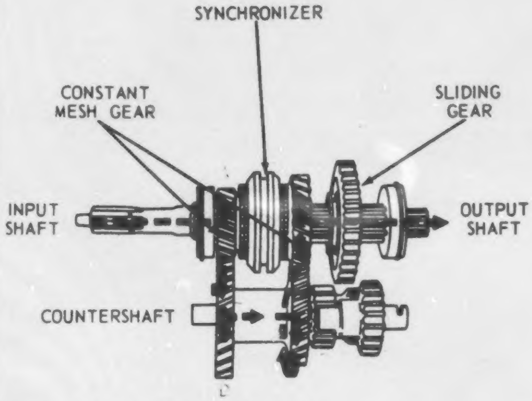
Check the student's performance in the following elements of servicing a constant-mesh transmission.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing a constant-mesh transmission, the student:				
1. removed the transmission according to the directions in the manufacturer's service manual	☐	☐	☐	☐
2. cleaned all parts and made an oil change	☐	☐	☐	☐
3. inspected the gear teeth for excessive wear and replaced as needed	☐	☐	☐	☐
4. inspected for worn bearings and replaced where needed	☐	☐	☐	☐
5. checked endplay in gears and shafts and adjusted or replaced if necessary	☐	☐	☐	☐
6. replaced bent or worn shafts	☐	☐	☐	☐
7. checked alignment of transmission to engine	☐	☐	☐	☐
8. checked shifter collars and hubs and replaced if necessary	☐	☐	☐	☐
9. replaced damaged or missing gaskets and case bolts	☐	☐	☐	☐
10. reassembled the transmission according to the manufacturer's instructions	☐	☐	☐	☐

Learning Activity Package Number 63



Courtesy of John Deere and Company

Servicing the Power Shift Transmission

Tractor Mechanics

Objective no. 165

INTRODUCTION

Power-shift (synchromesh) transmissions were designed to shift on-the-go. There are four types of synchronizers used in these transmissions: (1) Block-type, (2) Disk-and-plate-type, (3) Plain-type, and (4) Pin-type. The power-shift transmission is the most complicated mechanical transmission. It is a challenge to learn about and service. In this learning activity package you will learn how to effectively service a power-shift transmission.

DIRECTIONS

Before you begin on this learning activity package, be sure you have completed Package 60, "Adjusting a Gear Train," Package 61, "Servicing a Sliding Gear Transmission," and Package 62, "Servicing a Constant-Mesh Transmission."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the manufacturer's service manual, solvents, oil, replacement parts and the necessary tools and checking equipment, service a power-shift transmission. All disassembly and reassembly must follow the instructions and meet the specifications given in the service manual. All excessively worn or defective parts will be replaced.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), pp. 3-5 through 3-9 and 3-12 through 3-13.

(or) ________________________

2 READ Instructions, SERVICING POWER-SHIFT TRANSMISSIONS.

(or) ________________________

3 STUDY the section on disassembly and reassembly of a power-shift transmission in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

4 OUTLINE the procedure for disassembly and reassembly of the power-shift transmission as found in the manufacturer's service manual.

(or) ________________________

5 PRACTICE servicing a power-shift transmission following the procedure outlined in Learning Activity 2.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Testing equipment

MATERIALS AND SUPPLIES NEEDED

Recommended solvent
Recommended oil
Replacement parts
Replacement gaskets

SAFETY

When removing transmission from tractor make sure tractor is secured by jacks, stands or chain hoist.

INSTRUCTIONS

SERVICING POWER-SHIFT TRANSMISSIONS

In servicing a power-shift transmission, the following procedure should be used:

1. Remove the transmission from the tractor acording to directions in the manufacturer's service manual for the designated tractor.

2. Clean all parts.

3. To prevent serious problems:

   a. inspect gear teeth for excessive wear or breaks and replace as needed.

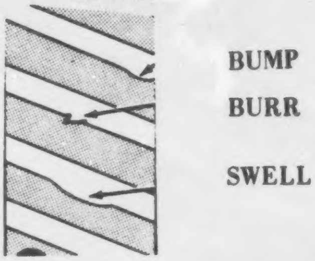


Figure 1 Courtesy of John Deere and Company

   b. inspect for worn bearings and replace as needed.

   c. inspect for defective or plugged transmission oil lines or passages in shaft and replace or repair as needed.

   d. inspect for broken or distorted shifter detent springs or for defective detent balls; replace as needed.

   e. inspect for worn splines and replace as needed.

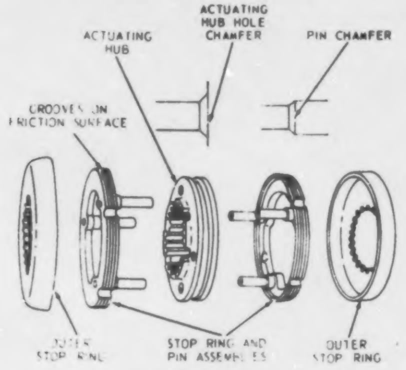
   f. check synchronizing units for damage, replacing parts when needed.

4. Replace all damaged or missing gaskets and case bolts.

5. Reassemble all parts, make oil change, and replace transmission according to the manufacturer's instructions and specifications.

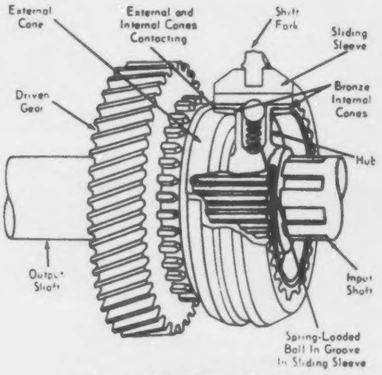
STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
POWER-SHIFT TRANSMISSIONS

1. Label each of the following types of power-shift (synchromesh) transmissions.

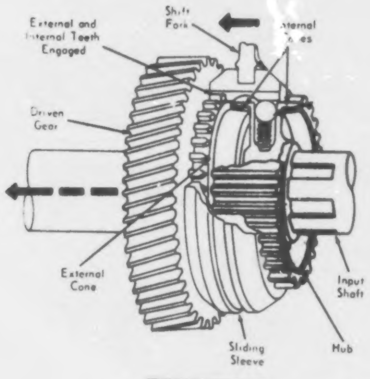

ACTUATING HUB
ACTUATING HUB HOLE CHAMFER
PIN CHAMFER
GROOVES ON FRICTION SURFACE
OUTER STOP RING
STOP RING AND PIN ASSEMBLIES
OUTER STOP RING

Courtesy of John Deere and Company

a. ______________________________


External Cone
External and Internal Cones Contacting
Shift Fork
Sliding Sleeve
Driven Gear
Bronze Internal Cones
Hub
Output Shaft
Input Shaft
Spring-Loaded Ball In Groove In Sliding Sleeve

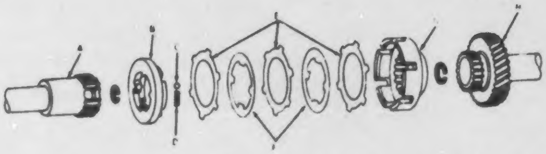
MOVING TOWARD ENGAGEMENT


External and Internal Teeth Engaged
Shift Fork
Internal Cones
Driven Gear
External Cone
Input Shaft
Sliding Sleeve
Hub

FULLY ENGAGED

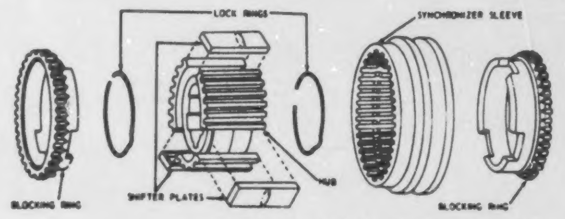
Courtesy of John Deere and Company

b. ______________________________



Courtesy of John Deere and Company

c. ______________________________


LOCK RINGS
SYNCHRONIZER SLEEVE
HUB
BLOCKING RING
SHIFTER PLATES
BLOCKING RING

Courtesy of John Deere and Company

d. ______________________________

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

a. pin-type synchronization
b. plain-type synchronization
c. disk- and plate-type synchronization
d. block-type synchronization

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE POWER-SHIFT TRANSMISSION.

Service the power-shift transmission on the designated tractor.

NOT WRITE ON THIS PAGE

LAP TM–63

Student ______________________

Date ______________________

SERVICING THE POWER-SHIFT TRANSMISSION

Instructor's Final Checklist

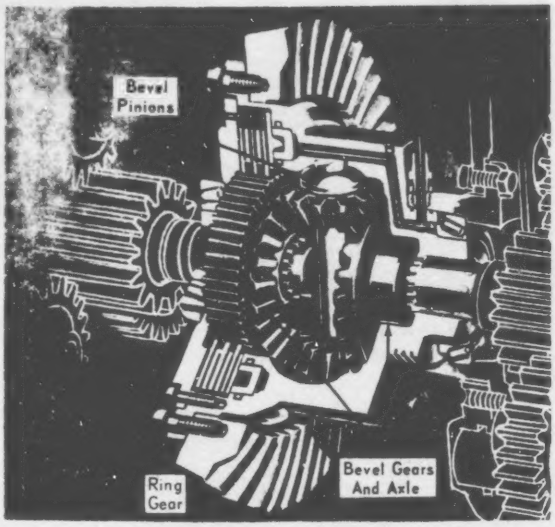
Check the student's performance in the following elements of servicing the power-shift transmission.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. To service a power-shift transmission, the student:				
a. removed the transmission from the tractor according to directions in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
b. cleaned all parts and made an oil change	[ ]	[ ]	[ ]	[ ]
c. inspected the gear teeth for excessive wear or breaks and replaced as needed	[ ]	[ ]	[ ]	[ ]
d. inspected bearings and replaced worn or damaged ones	[ ]	[ ]	[ ]	[ ]
e. inspected and replaced when needed, defective or plugged transmission oil lines and shafts	[ ]	[ ]	[ ]	[ ]
f. inspected and replaced detent springs and detent balls when necessary	[ ]	[ ]	[ ]	[ ]
g. checked synchronizing units for damage, replacing parts when necessary	[ ]	[ ]	[ ]	[ ]
h. replaced worn splines	[ ]	[ ]	[ ]	[ ]
i. replaced all damaged or missing gaskets and bolts	[ ]	[ ]	[ ]	[ ]
j. reassembled parts and replaced transmission according to the manufacturer's instructions and specifications	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 64



Courtesy of John Deere and Company

Repairing Differentials

Tractor Mechanics

Objective no. 169

INTRODUCTION

For a tractor to go forward in a straight line both drive wheels must turn at the same speed and pull their own load. But to turn sharp corners the tractor must have drive wheels capable of turning at different rates of speed. The differential provides for both functions: it transmits power to both drive wheels, while allowing the wheels to turn at different rates. Differentials are relatively trouble-free assemblies. Regular service is usually limited to maintaining the correct lubricant level and changing the lubricant at specified intervals. When differential repairs become necessary, however, considerable disassembly of the tractor is required. In this learning activity package you will learn how to repair differentials.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the manufacturer's service manual for the designated tractor and the necessary tools and equipment, repair the differential. Disassembly and reassembly must be in the order specified in the service manual. All parts will be clean, lubricated as specified, and torqued to specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company) pp. 7-1 and 7-2.

(or) ______________________________

2 READ the section on differentials in the manufacturer's service manual for the designated tractor, or the I & T Shop Manual.

(or) ______________________________

3 READ Instructions, REPAIRING DIFFERENTIALS.

(or) ______________________________

4 CHECK YOUR KNOWLEDGE of differentials by taking Student Self-Check I, UNDERSTANDING DIFFERENTIALS.

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) ______________________________

6 PRACTICE repairing differentials. Follow the procedure outlined in Learning Activity 3 and the mnaufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's Tool Kit
Hydraulic Jack
Chain Hoist
Jack Stand

MATERIALS AND SUPPLIES NEEDED

Replacement Parts

SAFETY

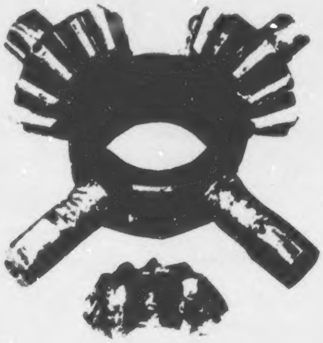
Make sure the tractor is secured by chain hoist, hydraulic jack or jack stands before and after removing the differential.

INSTRUCTIONS

REPAIRING DIFFERENTIALS

When repairing differentials, the following procedure should be used:

1. Follow instructions in the manufacturer's service manual to gain access to the differential assembly.
2. Remove differential assembly from housing.
3. Disassemble and clean differential according to service manual instructions.
4. Inspect all parts for wear or damage.



Courtesy of John Deere and Company

Figure 1. Spider arms and side pinions are discolored by heat. Evidence of metal to metal contact, scoring, and seizing.

This kind of damage is caused by inadequate lubrication, wheel spinning, or an overload.

Any of the causes results in the loss of lubricating film between the mating surfaces. Without the oil protection, friction causes the contacting areas to overheat, score, and finally seize if running is continued.

5. Clean thoroughly.
6. Lubricate parts as required.
7. Reassemble the differential according to the service manual, using new parts as needed.
8. Reinstall differential assembly in housing and adjust carrier bearing preload to specifications.
9. Check ring gear and pinion adjustment. Adjust as needed. (See Learning Activity Package 66)
10. Reassemble tractor and test drive.

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

UNDERSTANDING DIFFERENTIALS

Answer the following:

1. What two purposes does the differential assembly serve?

2. Name two adjustments made in differential repair.

3. What kind of gears are connected to the differential output?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. a. Transmits power at right angles.
   b. Allows each wheel to transmit power at its own speed.
2. a. Carrier bearing preload.
   b. Ring gear and pinion adjustment.
3. Bevel gears.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPAIRING DIFFERENTIALS.

Repair the differential on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–64

Student ____________________

Date ____________________

REPAIRING DIFFERENTIALS

Instructor's Final Checklist

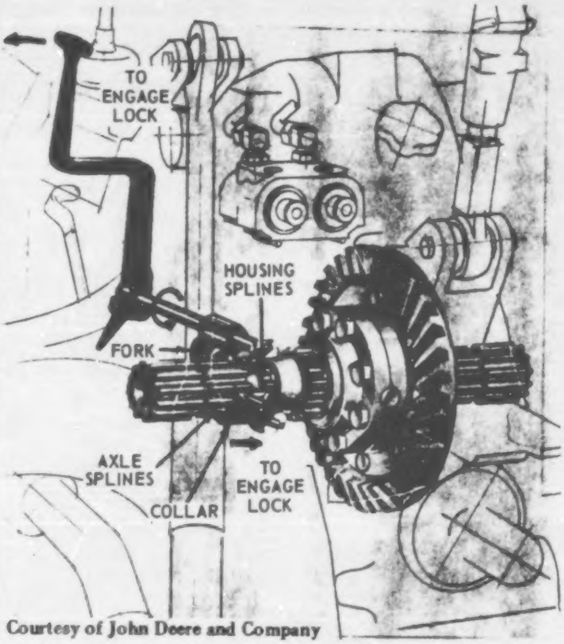
Check the student's performance in the following elements of repairing differentials.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

When repairing a differential, the student:	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. removed differential assembly	☐	☐	☐	☐
2. disassembled and cleaned differential	☐	☐	☐	☐
3. inspected all parts for wear or damage	☐	☐	☐	☐
4. cleaned and lubricated	☐	☐	☐	☐
5. reassembled with new parts as needed	☐	☐	☐	☐
6. reinstalled differential assembly in main housing	☐	☐	☐	☐
7. adjusted carrier bearing	☐	☐	☐	☐
8. checked and, if necessary, adjusted ring gear and pinion	☐	☐	☐	☐
9. reassembled tractor	☐	☐	☐	☐

Learning Activity Package Number 65



Courtesy of John Deere and Company

Servicing Differential Locks

Tractor Mechanics

Objective no. 171

INTRODUCTION

Under difficult field conditions, if one driving wheel loses traction the differential will allow it to spin while the other driving wheel stands still. A differential lock, by blocking normal differential action, causes both wheels to turn at the same speed. Occasional adjustment may be necessary to compensate for normal wear. Repair work is required if linkage adjustment will not restore the differential lock to correct operation. In this learning activity package you will learn how to adjust and repair differential locks.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using a designated tractor and the manufacturer's service manual, the necessary tools, supplies, and replacement parts, service the differential locks (mechanical and hydraulic). All worn or damaged parts must be repaired or replaced according to manufacturer's specifications. All parts must be clean on visual inspection. The differential and differential lock will be disassembled and reassembled in the order specified in the service manual.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), pp. 7-1 through 7-4.

(or) ____________________

2 CHECK YOUR KNOWLEDGE of differential locks by taking Student Self-Check I, UNDERSTANDING THE DIFFERENTIAL LOCK.

3 READ the section on differentials in the manufacturer's service manual for the designated tractor, or the I & T Shop Manual.

(or) ____________________

4 PRACTICE servicing a differential. Use Instructions, SERVICING DIFFERENTIAL LOCKS, and the manufacturer's service manual.

5 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement parts

SAFETY

Make sure the tractor is securely resting on hydraulic jack or stands when removing the wheel.

INSTRUCTIONS

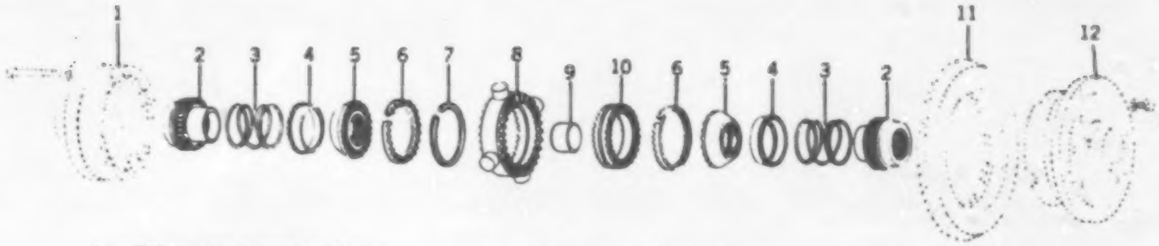
SERVICING DIFFERENTIAL LOCKS

In adjusting the differential lock, the following procedure should be used:

1. Remove pins securing operating lever to operating rod.
2. Depress lever until operating fork contacts the differential lock sliding coupling.
3. Loosen stop screw lock nut and rotate the differential lock stop screw clockwise until it contacts the bottom of the slot in the differential lock fork; contact point is observed when operating lever begins to move.
4. Turn adjusting screw back one quarter turn and tighten lock nut.
5. Depress the operating lever, with foot pedal resting on the platform, until the differential coupling is fully engaged.
6. Loosen lock nut and adjust length of operating rod until clevis pin can be inserted to connect the operating rod to the lever without compressing the spring in the operating rod.
7. Remove clevis pin and shorten operating rod by one turn; reset clevis pin.
8. Tighten lock nut and fit the cotter pin in place.

In overhauling the differential lock assembly, the following procedure should be used:

1. Remove left hand wheel and fender.
2. Disconnect electrical wiring and brake linkage to gain access to rear axle.
3. Drain oil from rear axle center housing.
4. Disassemble according to instructions in service manual.



1 — Differential Housing Cover
2 — Side Gear (2 Used)
3 — Spring (2 Used)
4 — Spring Retainer (2 Used)
5 — Driven Clutch (2 Used)
6 — Cam Holdout Ring (2 Used)
7 — Snap Ring
8 — Spider
9 — Stop
10 — Center Cam
11 — Ring Gear
12 — Differential Housing

Courtesy of John Deere and Company

Figure 1. Automatic (no-spin) differential lock in exploded view.

5. Inspect and clean all parts.
6. Repair or replace parts where necessary, following instructions in the service manual.
7. Assemble all parts.
8. Replace oil in rear axle center housing.
9. Connect electrical wiring and brake linkage.
10. Replace wheel and fender.

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

UNDERSTANDING THE DIFFERENTIAL LOCK

1. Name three types of differential locks.
2. The differential lock locks the gear shift lever. (T or F)
3. Why is the hydraulic lock sometimes linked to the brake pedal?
4. Incorrect adjustment of ring-gear and pinion will cause a noisy differential. (T or F)
5. Incorrect linkage adjustment will cause the lock not to hold. (T or F)

Check your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. mechanical, automobile, hydraulic
2. False
3. To prevent turning the machine with the differential lock engaged.
4. True
5. True

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING DIFFERENTIAL LOCKS.

Service the differential lock on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP **TM–65**

Student ____________________

Date ____________________

SERVICING DIFFERENTIAL LOCKS

Instructor's Final Checklist

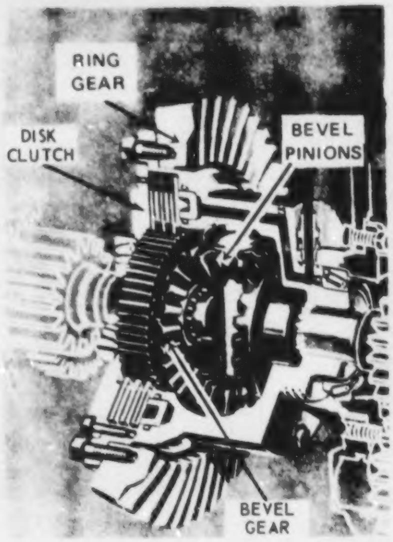
Check the student's performance in the following elements of servicing differential locks.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing differential locks, the student:				
1. checked manufacturer's service manual for instructions	☐	☐	☐	☐
2. removed pins, secured lever	☐	☐	☐	☐
3. loosened lock nut and adjusted length of operating rod	☐	☐	☐	☐
4. tightened lock nut and fit cotter pin in place	☐	☐	☐	☐
5. checked for proper operation	☐	☐	☐	☐

Learning Activity Package Number 66



Courtesy of John Deere and Company

Adjusting the Ring Gear and Pinions

Tractor Mechanics

Objective no. 167

INTRODUCTION

A ring gear and pinion assembly is used in most tractors to transmit the power from the transmission output to the differential. This arrangement not only changes the direction of the power flow, but decreases the speed and increases the torque. These gears are usually of the spiral-level type; they require accurate adjustment to prevent undesirable noise and excessive wear. In this learning activity package you will learn how to adjust a ring gear and pinion.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the manufacturer's service manual for the designated tractor, a complete set of mechanic's tools, and a dial indicator, correct the adjustment of the ring gear and pinion on the differential. The adjustment must be to the manufacturer's specifications, all parts will be reassembled and installed according to the manufacturer's directions, and there should be no damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), pp. 1-20 and 1-21.

(or) ______________________

2 READ *Fundamentals of Service: Tractors* (John Deere Company), pp. 80-86.

(or) ______________________

3 CHECK YOUR KNOWLEDGE of ring gear and pinion adjustment by taking the Student Self-Check, ADJUSTING RING GEAR AND PINION.

(or) ______________________

4 READ the section on the ring gear and pinion in the manufacturer's service manual for the designated tractor, or the I & T Shop Manual.

5 PRACTICE adjusting ring gear and pinion using Instructions, ADJUSTING RING GEAR AND PINION, and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Dial indicator
Manufacturer's special tools (sometimes required)
Feeler gauge
Spring scales
Torque wrench

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

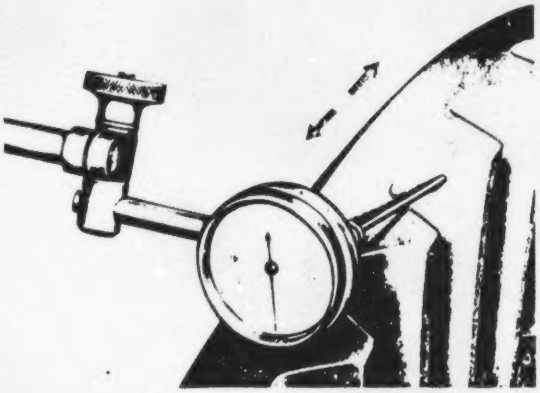
Make sure loose clothing does not catch in moving gears.

INSTRUCTIONS

ADJUSTING RING GEAR AND PINION

When adjusting the ring gear and pinion, the following procedure should be used:

1. Following the instructions in the manufacturer's service manual for the tractor in question, remove parts necessary to give access to ring gear and pinion.
2. Using a dial indicator, check the ring gear backlash at several locations on the ring gear.



Courtesy of John Deere and Company

3. Check readings against manufacturer's specifications and adjust ring gear and pinion to manufacturer's specifications as shown in the service manual.
4. Reassemble and/or reinstall all parts.

STUDENT SELF-CHECK

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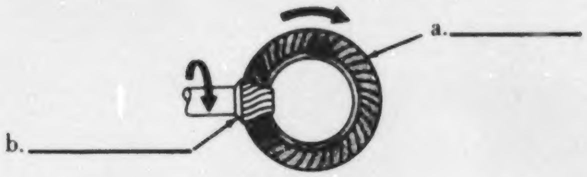
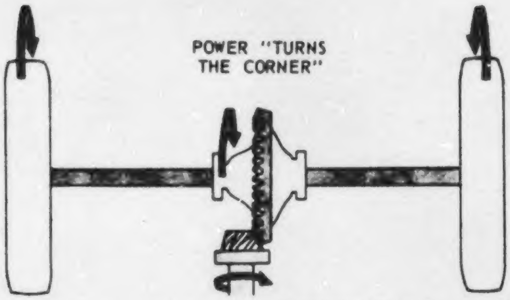
ADJUSTING RING GEAR AND PINION

1. Label the parts of the following diagram.





Courtesy of John Deere and Company

2. List at least two items to be checked when servicing the ring gear and pinion.

   a.
   b.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING RING GEAR AND PINION.

Correct the adjustment of the ring gear and pinion on the designated tractor.

CORRECT RESPONSES

1. a. Ring gear
   b. Pinion gear
2. a. check all parts for wear
   b. check mesh position of pinion gear

DO NOT WRITE ON THIS PAGE

LAP TM–66

Student ____________________

Date ____________________

ADJUSTING RING GEAR AND PINION

Instructor's Final Checklist

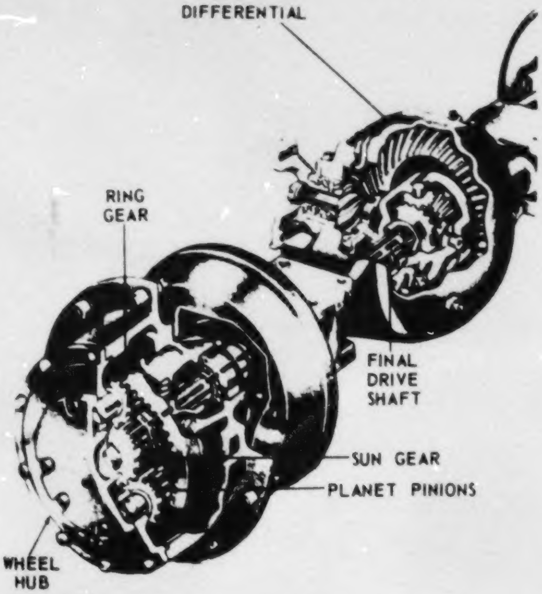
Check the student's performance in the following elements of adjusting ring gear and pinion.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In adjusting ring gear and pinion, the student:				
1. checked manufacturer's service manual for directions	☐	☐	☐	☐
2. removed parts necessary to gain access to ring gear	☐	☐	☐	☐
3. checked the backlash at several points using a dial indicator	☐	☐	☐	☐
4. checked readings against manufacturer's specifications	☐	☐	☐	☐
5. adjusted gear and pinion to specifications	☐	☐	☐	☐
6. reassembled all parts	☐	☐	☐	☐

Learning Activity Package Number 67



Courtesy of John Deere and Company

Preloading Axle Bearings

Tractor Mechanics

Objective no. 168

INTRODUCTION

Axles that are supported by tapered roller bearings often require a preload, or tension, to hold the bearings in correct position. In this learning activity package you will learn how to adjust the preload on an axle.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using a designated tractor and the manufacturer's service manual, a set of spacers, and all necessary tools, preload the bearings on the axle shaft. The correct spacer as outlined in the service manual will be used, the dial indicator reading must be the same as the instructor's, and all parts will be reassembled according to manufacturer's instructions with no parts damaged.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (John Deere Company), p. 8-7.

(or) ______________________

2 READ the section on axle bearings in the manufacturer's service manual for the designated tractor, or the I & T Shop Manual.

(or) ______________________

3 READ Instructions, PRELOADING AXLE BEARINGS.

(or) ______________________

4 CHECK YOUR KNOWLEDGE by taking Student Self-Check I, PRELOADING AXLE BEARINGS.

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this module.

(or) ______________________

6 PRACTICE preloading axle bearings. Follow the directions in the manufacturer's service manual and Instructions, PRELOADING AXLE BEARINGS.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Dial indicator
Torque wrench
Spring scales

MATERIALS AND SUPPLIES NEEDED

Spacers
Seals

SAFETY

Make sure tractor is secured on stands.

PRELOADING AXLE BEARINGS

When preloading axle bearings, one of the following procedures should be used:

A. For bearing adjusted to a torque specification:

1. Remove all parts necessary to free axle from drive gears.
2. Remove axle seal(s).
3. Be sure bearings are clean and properly lubricated.
4. Check rolling torque of axle (not starting torque).
5. Compare rolling torque with manufacturer's specifications.

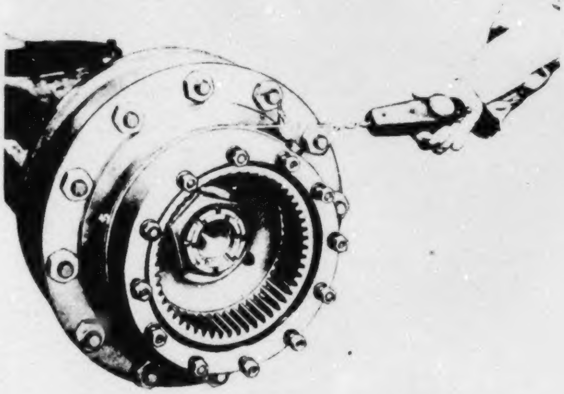


Figure 1. Checking bearing preload with pull scale.
Courtesy of John Deere and Company

6. Tighten or loosen as needed to get correct torque.
7. Check torque several times to be sure.
8. Reassemble. (Use new seals if needed.)

B. For bearing adjusted with shims or a spacer:

1. With axle and bearings in place, install spacer or extra shims as specified by manufacturer's service manual.
2. Check axle endplay using the dial indicator.

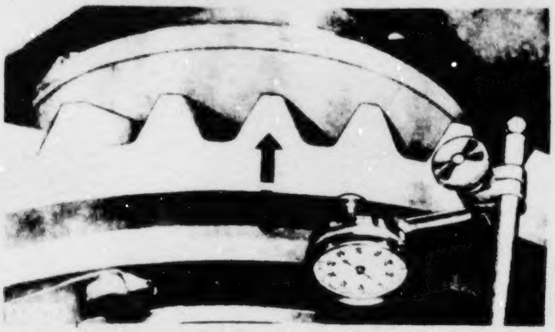


Figure 2. Checking Endplay On Gears and Shafts
Courtesy of John Deere and Company

3. Remove spacer and/or shims to obtain specified preload.
4. Complete reassembly.

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
PRELOADING AXLE BEARINGS

Answer the following questions:

1. What is meant by "preloading" the bearings?
2. What can happen if bearings are not adjusted correctly?
3. What are two ways of measuring rolling torque?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, PRELOADING AXLE BEARINGS.

Preload the bearings on the axle shaft of the designated tractor.

CORRECT RESPONSES

1. Placing them under slight tension
2. Excessive wear or break-down
3. Torque wrench; cord and pull-scale

DO NOT WRITE ON THIS PAGE

LAP TM–67

Student ____________________

Date ____________________

PRELOADING AXLE BEARINGS

Instructor's Final Checklist

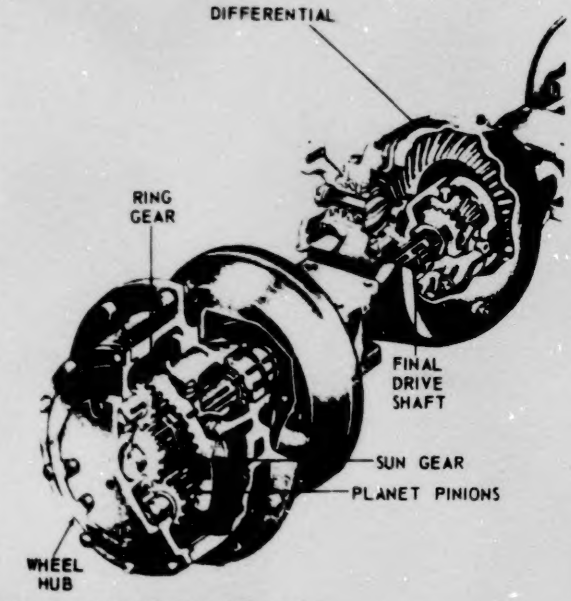
Check the student's performance in the following elements of preloading axle bearings.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In preloading axle bearings adjusted to a torque specification, the student:				
a. gained access to axle	☐	☐	☐	☐
b. removed seals	☐	☐	☐	☐
c. cleaned and lubricated bearings as necessary	☐	☐	☐	☐
d. checked rolling torque	☐	☐	☐	☐
e. adjusted to obtain correct torque	☐	☐	☐	☐
f. re-checked rolling torque	☐	☐	☐	☐
g. reassembled	☐	☐	☐	☐
2. In preloading axle bearings adjusted with a spacer or shims, the student:				
a. gained access to axle	☐	☐	☐	☐
b. installed spacer or extra shims as specified	☐	☐	☐	☐
c. checked endplay	☐	☐	☐	☐
d. adjusted to specified preload	☐	☐	☐	☐
e. reassembled	☐	☐	☐	☐

Learning Activity Package Number 68



Courtesy of John Deere and Company

Replacing Axle Seals and Gaskets

Tractor Mechanics

Objective no. 170

INTRODUCTION

An axle seal serves two purposes. One is to keep the lubricant from spilling out of the axle housing. The other is to keep dirt or other foreign matter from entering around the axle. Usually the axle must be removed to replace the seal. When any parts of the axle housing are disturbed, it is advisable to install new gaskets. In this learning activity package you will learn how to replace axle seals and gaskets.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Using a designated tractor and the manufacturer's service manual, new gaskets and seals, and the necessary tools, equipment, and supplies, replace the brake and axle seals and gaskets. All seals and gaskets will be the right ones for their location and must show no signs of leaks. All parts will be reassembled to manufacturer's instructions and specifications, and there will be no damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Bearings and Seals* (John Deere Company), pp. 43-49.

(or) ____________________

2 READ the section on axle seals in the manufacturer's service manual for the designated tractor, or the I & T Shop Manual.

(or) ____________________

3 READ Instructions, REPLACING AXLE SEALS AND GASKETS.

(or) ________________________

4 CHECK YOUR KNOWLEDGE of seals by taking Student Self-Check I, REPLACING SEALS.

5 PRACTICE removing and replacing axle seals. Use Instructions, REPLACING AXLE SEALS AND GASKETS and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement seals
Replacement gaskets

SAFETY

Make sure tractor is resting securely on stands.

INSTRUCTIONS

REPLACING AXLE SEALS AND GASKETS

In replacing axle seals and gaskets, the following procedure should be used:

1. Follow instructions in the manufacturer's service manual to reach seals and gaskets.
2. Remove old seals and gaskets.
3. Clean seal and gasket seats thoroughly without removing any metal.
4. Install and seal new seals and gaskets making sure each is properly seated.
5. Reassemble according to manufacturer's instructions and specifications.

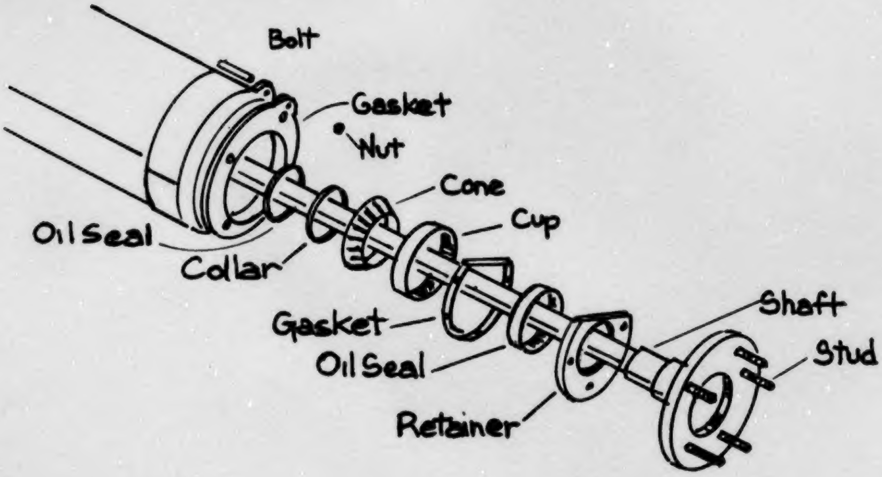


Figure 1. Typical arrangement of axle, seals and bearings.

STUDENT SELF CHECK

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REPLACING SEALS

1. List two types of seals.
2. A piston ring is one type of seal. (T or F)
3. Another name for a radial lip seal is ________________.
4. Two types of radial lip seals are __________ and __________.
5. New seals should always be installed when a shaft is removed. (T or F)
6. __________ seals are used to seal moving parts.
7. __________ seals are used to seal fixed parts.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING AXLE SEALS AND GASKETS.

Replace the brake and axle seals and gaskets on the designated tractor.

CORRECT RESPONSES

1. Dynamic, static
2. True
3. Oil seal
4. Bonded seals, assembled seals
5. True
6. Dynamic
7. Static

DO NOT WRITE ON THIS PAGE

LAP TM–68

Student ____________________

Date ____________________

REPLACING AXLE SEALS AND GASKETS

Instructor's Final Checklist

Check the student's performance in the following elements of replacing axle seals and gaskets.

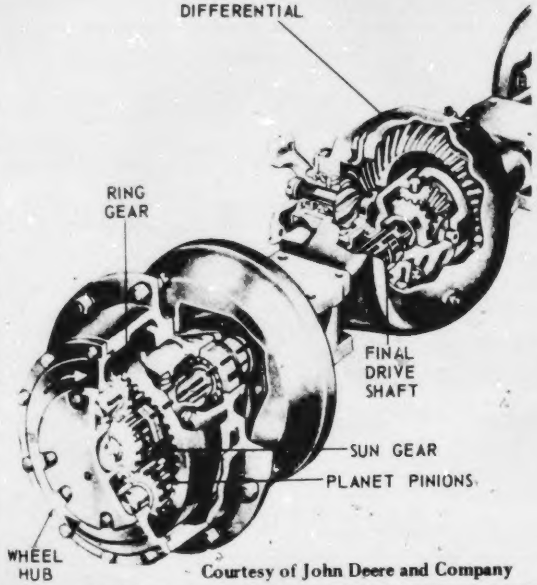
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
In replacing axle seals and gaskets, the student:	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. checked manufacturer's service manual for directions	☐	☐	☐	☐
2. removed old seals and checked for damaged seats	☐	☐	☐	☐
3. cleaned seal seats	☐	☐	☐	☐
4. installed new seals	☐	☐	☐	☐
5. reassembled according to instructions in manufacturer's service manual	☐	☐	☐	☐

Learning Activity Package Number 69

Adjusting Endplay in the Final Drive



Courtesy of John Deere and Company

Tractor Mechanics

Objective no. 173

INTRODUCTION

In final drives that are supported by ball bearings, there must be a controlled amount of endplay (lateral shaft movement) to allow the bearings to operate freely. In this learning activity package you will learn how to adjust the endplay in the final drive.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using a designated tractor and the manufacturer's service manual, a dial indicator, shims and the necessary tools, adjust the endplay in the final drive. All parts should be disassembled and reassembled according to manufacturer's instructions, and the endplay must be within the limits specified in the service manual.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), pp. 8-7 and 8-8.

(or) ______________________________

2 CHECK YOUR KNOWLEDGE of end play adjustment by taking the Student Self-Check, ADJUSTING ENDPLAY IN A FINAL DRIVE.

(or) ______________________________

3 READ Instruction Sheet I, ADJUSTING ENDPLAY IN A FINAL DRIVE.

(or) ______________________________

4 READ the section on final drive adjustment in the manufacturer's service manual for the designated tractor, or I & T Shop Manual.

(or) ______________________________

5 PRACTICE adjusting endplay in the final drive on the shop tractor. Follow the procedure outlined in Learning Activity 3 and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Dial indicator

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

Make sure tractor is secured on stands when wheels are removed.

INSTRUCTIONS

ADJUSTING ENDPLAY IN A FINAL DRIVE

In adjusting endplay in a final drive, the following procedure should be used:

1. Remove all parts necessary to reach gears and shafts in final drive following directions in the manufacturer's service manual.
2. To check the endplay, mount a dial indicator against the side of a gear or the end of a shaft. Then pry the gear or shaft in both directions. Note the readings. The difference between the two readings is the endplay.

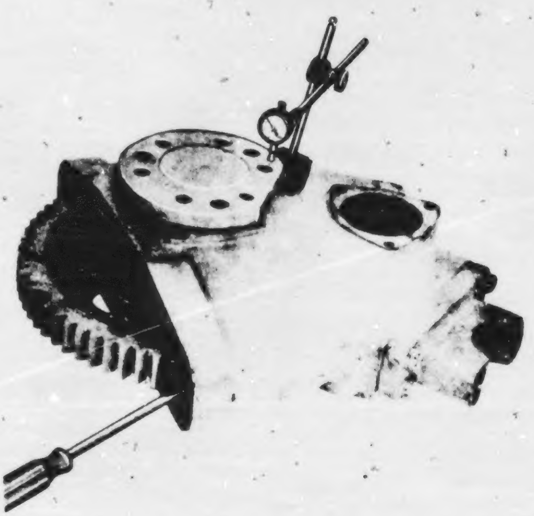


Figure 1. Checking final drive shaft endplay with a dial indicator.

3. Adjust the endplay to specifications with shims or adjusting nuts according to manufacturer's recommendation.
4. Reassemble.

STUDENT SELF-CHECK

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ADJUSTING ENDPLAY IN THE FINAL DRIVE

1. All drive axles require endplay. (True–False)
2. The major tool used for measuring endplay is:
    a. a feeler gauge
    b. a spring scale
    c. a dial indicator

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. False
2. c

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING ENDPLAY IN THE FINAL DRIVE.

Adjust the endplay in the final drive on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP **TM–69**

Student ______________________

Date ______________________

ADJUSTING ENDPLAY IN THE FINAL DRIVE

Instructor's Final Checklist

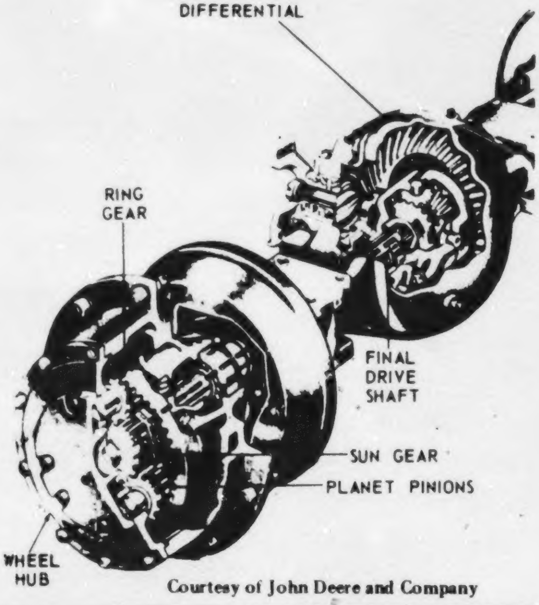
Check the student's performance in the following elements of adjusting endplay in the final drive.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
In adjusting the final drive endplay, the student:	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. gained access to final drive	☐	☐	☐	☐
2. measured endplay	☐	☐	☐	☐
3. adjusted endplay to specifications	☐	☐	☐	☐
4. reassembled tractor	☐	☐	☐	☐

Learning Activity Package Number 70



Courtesy of John Deere and Company

Servicing Bearings in the Final Drive

Tractor Mechanics

Objective no. 174

INTRODUCTION

The bearings of most final drives run in an oil bath. Except for lubricant checks, refills, and changes, these bearings generally do not require regular service. They need servicing only when they become noisy or when other repairs are made that could affect the bearings. In this learning activity package you will learn how to service bearings in a final drive.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor and the manufacturer's service manual, correct tools and equipment, solvent, grease and any needed replacement parts, install and adjust bearings in the final drive. The disassembly and assembly should follow manufacturer's instructions and specifications. All parts must be clean and undamaged.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), pp. 8-6 and 8-7.
(or) ______________________

2 READ *Fundamentals of Service: Identification of Parts Failures* (Deere & Company), pp. 8.1-8.7.
(or) ______________________

3 CHECK YOUR KNOWLEDGE of axle bearings by taking the Student Self-Check, FINAL DRIVE BEARINGS.

4 READ Instructions, SERVICING FINAL DRIVE BEARINGS.

(or) ______________

5 READ the section on final drives in the manufacturer's service manual for the designated tractor, or the I & T Shop Manual.

(or) ______________

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this package.

(or) ______________

7 PRACTICE servicing bearings on the shop tractor.

8 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 3

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Bearing drives

MATERIALS AND SUPPLIES NEEDED

Cleaning solvents
Grease
Replacement parts

SAFETY

Make sure tractor is securely resting on support stands.

INSTRUCTIONS

SERVICING FINAL DRIVE BEARINGS

When servicing the bearings in the final drive, the following procedure should be used:

1. Drain lubricant from final drives.
2. Disassemble parts necessary to reach bearings.
3. Remove bearings in question and clean thoroughly.
4. Inspect each bearing for wear or damage.

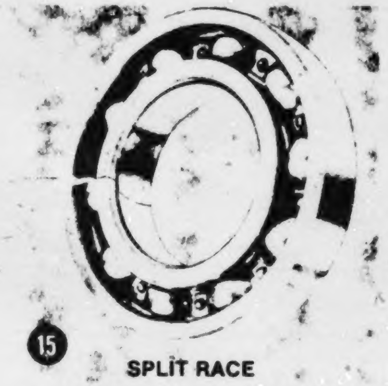


Figure 1. Split race caused by forcing the bearing onto a shaft too large for the inside diameter of the bearing race.

Courtesy of John Deere and Company

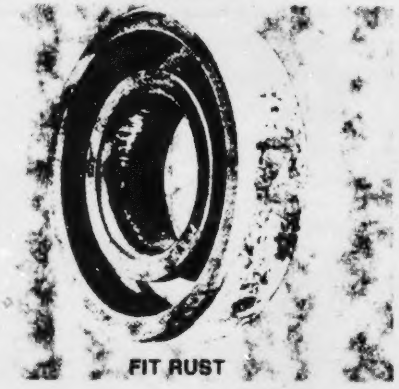


Figure 2. "Fit rust" or fretting corrosion, which results when the outer race fits too loosely in its housing. Sanding or removing this rust will only increase the loose fit. The bearing must be replaced.

Courtesy of John Deere and Company

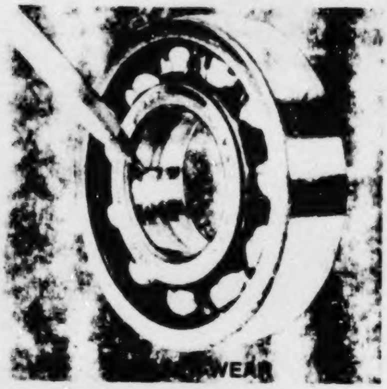


Figure 3. Creep wear caused by too loose of a fit between the shaft and the inside bore of the bearing. As this wear progresses, the inner race turns faster creating more friction and heat and leads to eventual bearing failure.

Courtesy of John Deere and Company

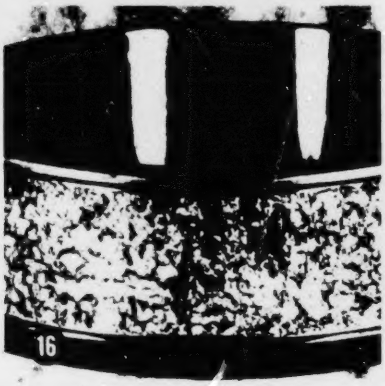


Figure 4. The bearing race in Fig. 4 is badly spalled from fatigue of metal. This fatigue occurred prematurely and could be eliminated by removing the preload or reducing it to the proper amount.

Courtesy of John Deere and Company

5. Replace or reinstall bearings and adjust to manufacturer's specifications.
6. Reassemble.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS PAGE !

FINAL DRIVE BEARINGS

1. Final drive bearings are usually

   a. roller type
   b. ball type
   c. sleeve type

2. List at least three causes of bearing failure.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING BEARINGS IN THE FINAL DRIVE.

Install and adjust bearings in the final drive on the designated tractor.

CORRECT RESPONSES

1. a
2. a) improper lubrication
   b) improper installation
   c) careless handling
   d) misalignment
   e) severe service
   f) vibration

DO NOT WRITE ON THIS PAGE

LAP TM–70

Student ____________________

Date ____________________

SERVICING BEARINGS IN THE FINAL DRIVE

Instructor's Final Checklist

Check the student's performance in the following elements of servicing bearings in the final drive.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

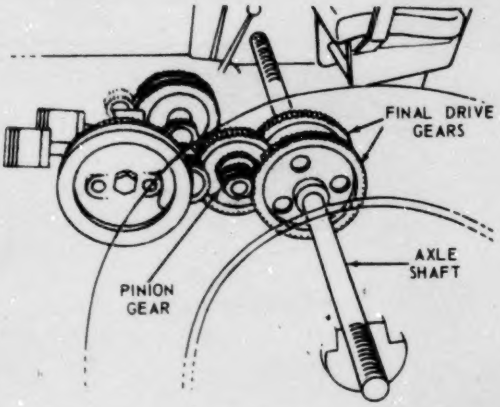
		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
	In servicing final drive bearings, the student:				
1.	drained lubricant from final drives	☐	☐	☐	☐
2.	removed bearings	☐	☐	☐	☐
3.	cleaned bearings	☐	☐	☐	☐
4.	inspected bearings	☐	☐	☐	☐
5.	replaced/reinstalled bearings	☐	☐	☐	☐
6.	adjusted bearings to specifications	☐	☐	☐	☐
7.	reassembled the tractor	☐	☐	☐	☐

Learning Activity Package Number 71

Servicing a Pinion Final Drive

Tractor Mechanics

Objective no. 175



Pinion Drive within the Differential Case

Courtesy of John Deere and Company

INTRODUCTION

The pinion and "Bull Gear" drive is the simplest type of reduction-gear final drive. It is used mostly in small and medium sized tractors. Repair service may include replacement of worn or damaged parts and adjustment of bearing preload or shaft endplay . In this learning activity package you will learn how to service a pinion final drive.

DIRECTIONS

Before you begin work on this learning activity package, be sure you have completed Package 69, "Adjusting End-Play in the Final Drive," and Package 70, "Servicing Bearings in the Final Drive."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor and manufacturer's service manual, proper tools, cleaning solution, and lubricants, and replacement parts, service a pinion final drive. All parts must be clean and lubricated. Disassembly and reassembly should follow manufacturer's recommendations. All parts must be torqued according to manufacturer's specifications, and there must be no damage to any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), pp. 8-1 through 8-4.

(or) ____________________

2 IDENTIFY at least one model of tractor with inboard pinion final drives and one with outboard final drives.

(or) ____________________

3 CHECK YOUR KNOWLEDGE of pinion final drives by taking the Student Self-Check, PINION FINAL DRIVES.

4 READ Instructions, SERVICING A PINION FINAL DRIVE.

(or) ____________________

5 READ the section on final drives in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

6 PRACTICE servicing a final drive on the shop tractor. Follow the procedure outlined in Instructions and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Recommended lubricants
Shop rags and solvents
Replacement parts

SAFETY

Disengage power to PTO shaft and shut off engine before servicing the drive shaft.

INSTRUCTIONS

SERVICING A PINION FINAL DRIVE

In servicing a pinion final drive, one of the following procedures should be used: (The procedure is determined by the location of the final drive.)

1. Pinion drive inside differential case:
   a. Follow instructions in the manufacturer's service manual, disassemble all parts necessary to reach pinion drive.
   b. Remove pinion gears, clean thoroughly, checking for wear or damage. Repair or replace parts where necessary.
   c. Reassemble pinion gears and adjust and torque to manufacturer's specifications.
   d. Reassemble gears in differential case to manufacturer's instructions and specifications.
2. Pinion drive on outer ends of final drives:
   a. Following instructions in the manufacturer's service manual, remove all parts necessary to reach the case or housing for pinion gears.

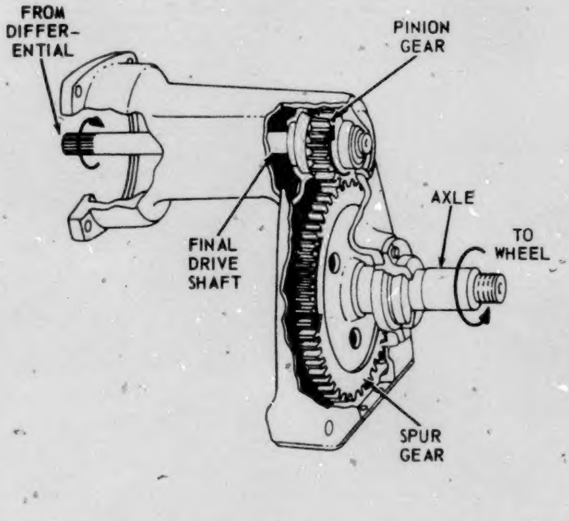


Figure 1 Pinion gear reduction on the outer ends of the final drives

Courtesy of John Deere and Company

b. Detach gear housing from the differential and wheels.

c. Remove pinion gear and spur gear from housing, discarding old lubricant. Clean, inspect for damage, and repair or replace parts if necessary.

d. Reassemble and adjust gears according to manufacturer's instructions and specifications and replace lubricant.

e. Reassemble gear housing and all other parts removed following directions in the service manual.

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

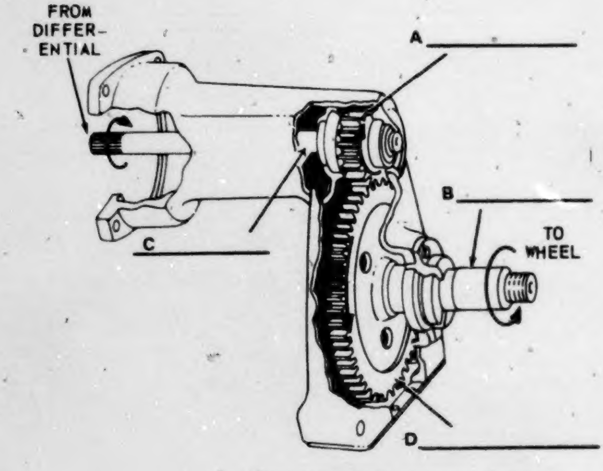
PINION FINAL DRIVES

1. List two types of pinion final drives.

a. ______________________________

b. ______________________________

2. Label the following drawing:



Courtesy of John Deere and Company

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A PINION FINAL DRIVE.

Service the final drive on the designated tractor.

CORRECT RESPONSES

1. a. those located within differential case
   b. those located on outer ends of final drive
2. a. pinion gear
   b. axle
   c. final drive shaft
   d. spur gear

DO NOT WRITE ON THIS PAGE

LAP TM–71

Student ______________________

Date ______________________

SERVICING A PINION FINAL DRIVE

Instructor's Final Checklist

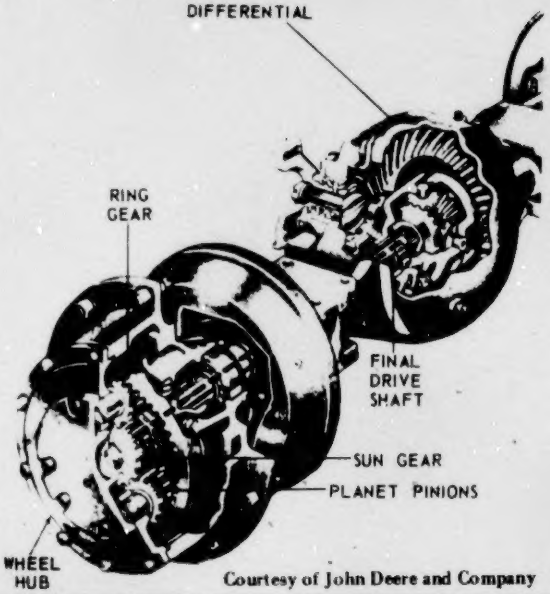
Check the student's performance in the following elements of servicing a pinion final drive.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
	In servicing a pinion final drive, the student:				
1.	drained final drive	[ ]	[ ]	[ ]	[ ]
2.	removed parts necessary to reach final drive	[ ]	[ ]	[ ]	[ ]
3.	removed final drive gears	[ ]	[ ]	[ ]	[ ]
4.	cleaned gears and bearings	[ ]	[ ]	[ ]	[ ]
5.	checked for damage	[ ]	[ ]	[ ]	[ ]
6.	replaced parts as necessary	[ ]	[ ]	[ ]	[ ]
7.	reassembled and torqued final drive to specifications	[ ]	[ ]	[ ]	[ ]
8.	installed lubricant	[ ]	[ ]	[ ]	[ ]
9.	reinstalled other parts that were removed	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 72



Courtesy of John Deere and Company

Servicing a Planetary Final Drive

Tractor Mechanics

Objective no. 176

INTRODUCTION

Planetary final advance drives are stronger, more durable under high loads, and more satisfactory in high horsepower tractors than other types of final drives. They are more complex than pinion final drives even though the procedure for their service and adjustment is similar. In this learning activity package you will learn how to service a planetary final drive.

DIRECTIONS

Before you begin work on this learning activity package, be sure you have completed Package 69, "Adjusting End Play in the Final Drive," Package 70, "Servicing Bearings in the Final Drive," and Package 71, "Servicing a Pinion Final Drive."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given the manufacturer's service manual and the needed tools, and replacement parts, service inboard and outboard mounted planetary devices. All parts will be thoroughly cleaned. Disassembly and reassembly must be in order of manufacturer's instructions. There will be no damage to any part.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), pp. 8-4 through 8-6.

(or) ____________________

2 IDENTIFY at least one model of tractor with inboard planetary final drives and one with outboard planetary final drives.

(or) ____________________

3 CHECK YOUR KNOWLEDGE of planetary final drives by taking the Student Self-Check, PLANETARY FINAL DRIVES.

4 READ Instructions, SERVICING PLANETARY FINAL DRIVES.

(or) ____________________

5 READ the section on final drives in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

6 PRACTICE servicing the planetary final drives on the shop tractor. Follow the procedure outlined in Instructions, SERVICING A PLANETARY FINAL DRIVE and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Recommended solvents
Recommended lubricants
Replacement parts

SAFETY

Make sure the tractor is securely resting on stands.

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INSTRUCTIONS

SERVICING PLANETARY FINAL DRIVES

In servicing planetary final drives, the following procedure should be used:

1. Refer to manufacturer's service manual for make, model, and year of tractor for disassembly instructions.
2. Disassemble the rear axle shaft assembly following the steps outlined in the service manual.
3. Drain lubricant if necessary.
4. Disassemble the planetary drive following steps outlined in the service manual.
5. Thoroughly clean and inspect all parts and replace parts which are worn or damaged.
6. Reassemble the planetary drive following steps outlined in service manual.
7. Reassemble the rear axle shaft assembly according to manufacturer's specifications.
8. Replace lubricant if it was drained.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A PLANETARY FINAL DRIVE.

Service the inboard and outboard mounted planetary drives on the designated tractor(s).

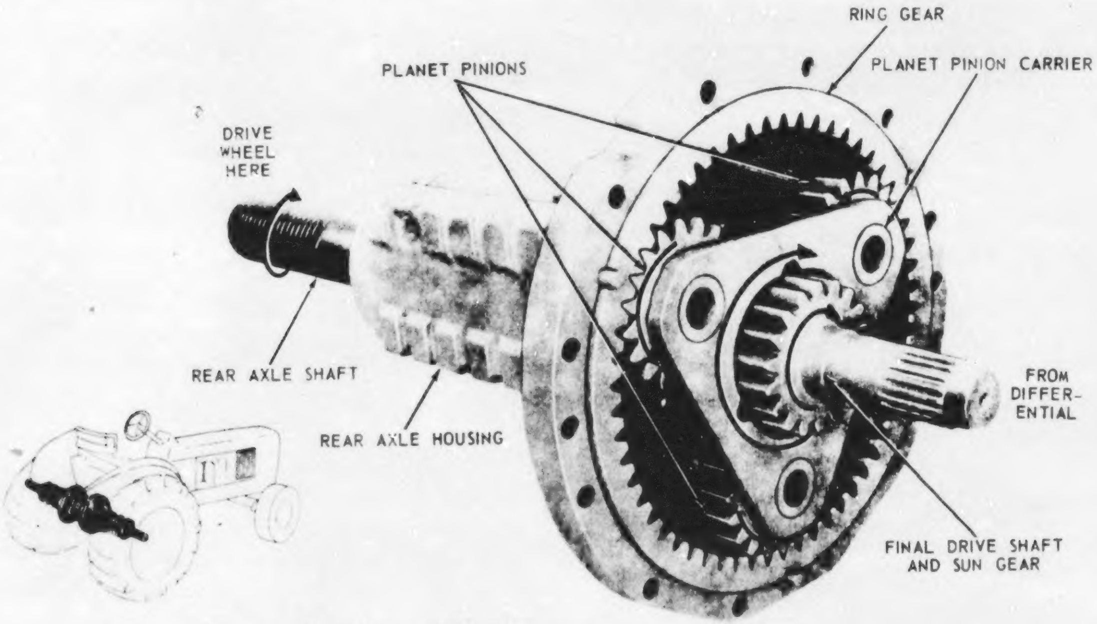
RING GEAR
PLANET PINIONS
PLANET PINION CARRIER
DRIVE WHEEL HERE
REAR AXLE SHAFT
REAR AXLE HOUSING
FROM DIFFERENTIAL
FINAL DRIVE SHAFT AND SUN GEAR

Figure 1 Final drive with Planetary Gears next to the Differential

Courtesy of John Deere and Company

STUDENT SELF CHECK

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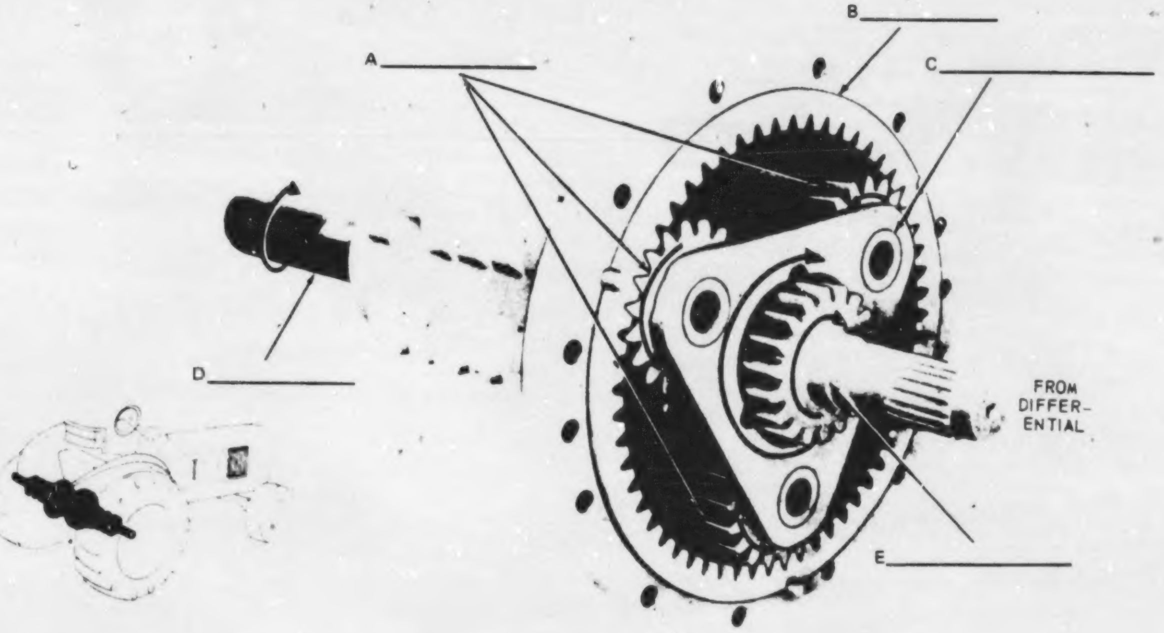
PLANETARY FINAL DRIVES

1. List the two types of final drives with planetary gears:

   a. ______________________________

   b. ______________________________

2. Label the following drawing:



a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

CORRECT RESPONSES

1. a. Inboard (planetary gear next to differential)
   b. Outboard (planetary gears at outer ends)
2. a. Planet Pinions
   b. Ring Gear
   c. Planet Pinion Carrier
   d. Rear Axle Shaft
   e. Final Drive Shaft and Sun Gear

DO NOT WRITE ON THIS PAGE

LAP TM–72

Student ______________________

Date ______________________

SERVICING A PLANETARY FINAL DRIVE

Instructor's Final Checklist

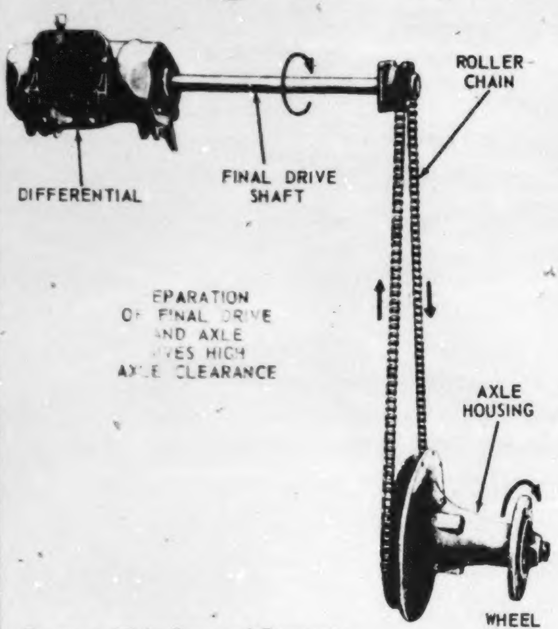
Check the student's performance in the following elements of servicing a planetary final drive.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing a planetary final drive, the student:				
1. disassembled rear axle shaft according to service manual instructions	[ ]	[ ]	[ ]	[ ]
2. disassembled planetary drive	[ ]	[ ]	[ ]	[ ]
3. cleaned and inspected all parts	[ ]	[ ]	[ ]	[ ]
4. replaced parts as needed	[ ]	[ ]	[ ]	[ ]
5. reassembled planetary drive with no damage to parts	[ ]	[ ]	[ ]	[ ]
6. reassembled axle shaft	[ ]	[ ]	[ ]	[ ]
7. drained lubricant	[ ]	[ ]	[ ]	[ ]
8. replaced lubricant	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 73



Courtesy of John Deere and Company

Servicing a Chain Final Drive

Tractor Mechanics

Objective no. 172

INTRODUCTION

A Chain final drive has the advantage of providing higher axle clearance than any other type of final drive. But chain drives do not have the strength and rigidity of gear drives. In addition, chain drives usually require more frequent adjustment. In this learning activity package you will learn how to service chain final drives.

DIRECTIONS

Before you start work on this learning activity package, be sure you have completed Package 69, "Adjusting Endplay in the Final Drive," and Package 70, "Servicing Bearings in the Final Drive."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Using a designated tractor and the manufacturer's service manual, a jack and blocks, and the necessary tools, adjust the chain in the final drive. The tension on the chain drive must be adjusted to manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), p. 8-6.

(or)____________________

2 IDENTIFY a model of tractor with chain final drives.

(or)____________________

3 CHECK YOUR KNOWLEDGE of chain final drives by taking the Student Self-Check, CHAIN FINAL DRIVES.

4 READ Instructions, SERVICING A CHAIN FINAL DRIVE.

(or)____________________

5 READ the section on final drives in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

6 PRACTICE servicing a chain drive on the shop tractor. Follow the procedure outlined in Learning Activity 4 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Jacks
Support stands

MATERIALS AND SUPPLIES NEEDED

Recommended lubricants
Replacement chains, links or sprockets

SAFETY

Make sure the tractor rests securely on the stands.

INSTRUCTIONS

SERVICING A CHAIN FINAL DRIVE

In servicing a chain final drive, the following procedure should be used:

1. Block wheels and jack up rear end of tractor.
2. Set safety stands under tractor.
3. Drain lubricant from chain housing.
4. Remove guards, covers, etc., necessary to inspect chain and sprockets.
5. Inspect chain and sprockets for excessive wear or damage. Replace as necessary.
6. Check bearing preload or endplay and adjust to manufacturer's specifications.
7. Replace seals and gaskets as needed.
8. Adjust chain tension according to manufacturer's specifications.
9. Reinstall covers, guards, etc., with proper gaskets.
10. Refill with correct lubricant.
11. Remove safety stands, lower jack, remove blocks, and test drive the tractor.

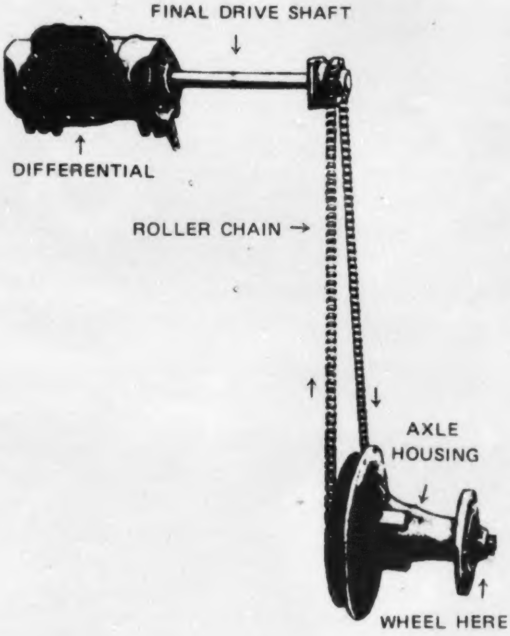


Figure 1 A Chain final drive
Courtesy of John Deere and Company

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STUDENT SELF CHECK

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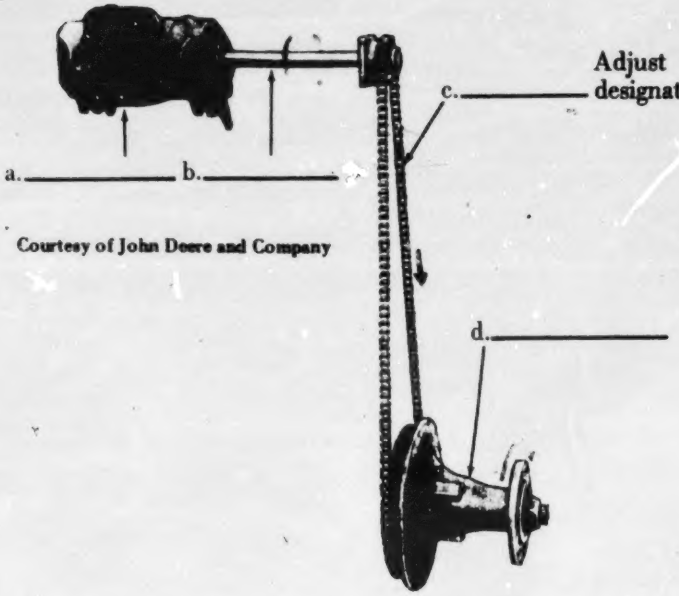
CHAIN FINAL DRIVES

1. Why are chain drives used on some tractors?

2. Label the following diagram:



Courtesy of John Deere and Company

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A CHAIN FINAL DRIVE.

Adjust the chain in the final drive on the designated tractor.

CORRECT RESPONSES

1. Because it is necessary to have the engine and body of some tractors raised to considerable heights to clear the crops being cultivated.

2. a. Differential
   b. Final Drive Shaft
   c. Roller Chain
   d. Axle Housing

DO NOT WRITE ON THIS PAGE

LAP TM–73

Student ____________________

Date ____________________

SERVICING A CHAIN FINAL DRIVE

Instructor's Final Checklist

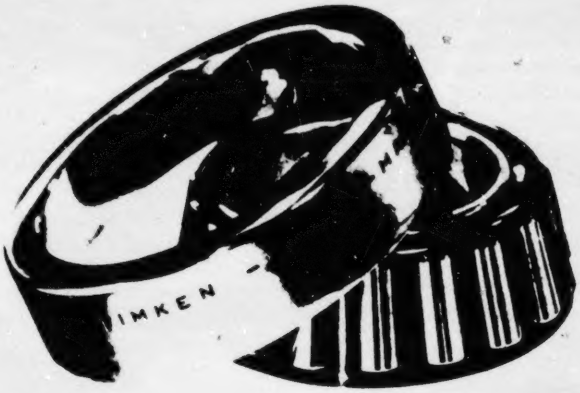
Check the student's performance in the following elements of servicing a chain final drive.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
In servicing a chain final drive, the student:	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. blocked wheels and jacked up rear end of tractor	☐	☐	☐	☐
2. set safety stands	☐	☐	☐	☐
3. drained chain housing	☐	☐	☐	☐
4. gained access to chain	☐	☐	☐	☐
5. inspected for damage and/or excessive wear and replaced parts as necessary	☐	☐	☐	☐
6. checked and/or adjusted bearing preload or endplay	☐	☐	☐	☐
7. replaced seals and gaskets as needed	☐	☐	☐	☐
8. adjusted chain to manufacturer's specifications	☐	☐	☐	☐
9. reassembled covers, guards, etc.	☐	☐	☐	☐
10. filled with lubricant	☐	☐	☐	☐
11. test operated the tractor	☐	☐	☐	☐

Learning Activity Package Number 74



Packing Wheel Bearings

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 134

INTRODUCTION

Many of the tractors a mechanic will bring into the shop will need to have the front wheel bearings packed with grease. The need for packing the bearings with grease is more important than ever today because of larger and heavier tractors and the use of front-mounted equipment such as hydraulic loaders and field equipment. Since bearings are packed only after 500 hours of use, this makes the job all the more important. In this learning activity package you will learn how to properly clean and pack a wheel bearing.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a mechanic's tool set, replacement parts, number 2 lithium grease, and shop rags, pack the wheel bearings on the designated tractor. When completed, there should be no drag or end play.

LEARNING ACTIVITIES

1 READ *Tractor Maintenance: Principles and Procedures* (AAVIM) pp. 114–119.

(or)____________________________

2 VIEW filmstrip, "Packing Wheel Bearings" from the series, "500 Hours of Operation" (AAVIM).

(or) ____________________________

3 CHECK YOUR KNOWLEDGE of the task by taking Student Self-Check I, PACKING WHEEL BEARINGS.

4 READ Instructions, PACKING WHEEL BEARINGS.

(or) ____________________________

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this module.

(or)____________________________

6 STUDY the section on packing wheel bearings in the manufacturer's service manual for the designated tractor. Be sure to make a note of the torque specifications.

(or) The I & T Shop Manual

7 PRACTICE removing wheel, cleaning wheel and bearings, repacking bearings, and reinstalling bearings and wheel on the designated tractor. Follow the procedure outlined in Learning Activity 4 and the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Torque wrench

MATERIALS AND SUPPLIES NEEDED

Replacement bearings,if needed
Recommended solvent (mineral spirits, diesel fuel, kerosene or agitene)
Recommended grease

SAFETY

Make sure the tractor is securely mounted on stands.

Avoid breathing solvent fumes, use solvent in a well ventilated area, and keep solvent away from sparks or flame.

PACKING WHEEL BEARINGS

In packing a wheel bearing, the following procedure should be used:

1. Lock the brakes; raise and block up the front end. (Caution: Use only approved jack stands to block up the front end.)
2. Remove hub cap, cotter pin, adjusting nut, thrust washer, and outer bearing cone.
3. Pull off the wheel hub containing bearing cups, cone, and seal.
4. Remove the inner cone, bearing cups, and seal from the hub.

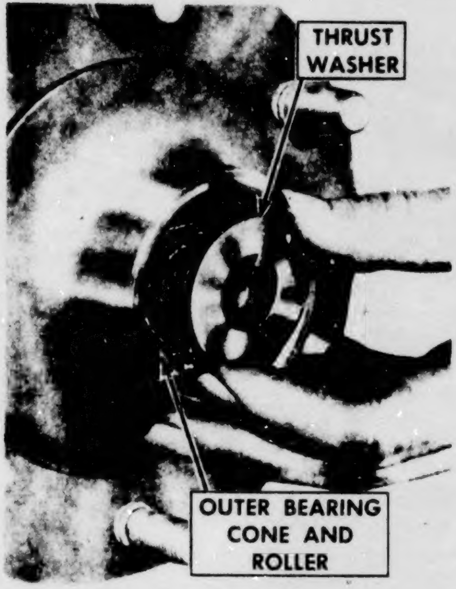
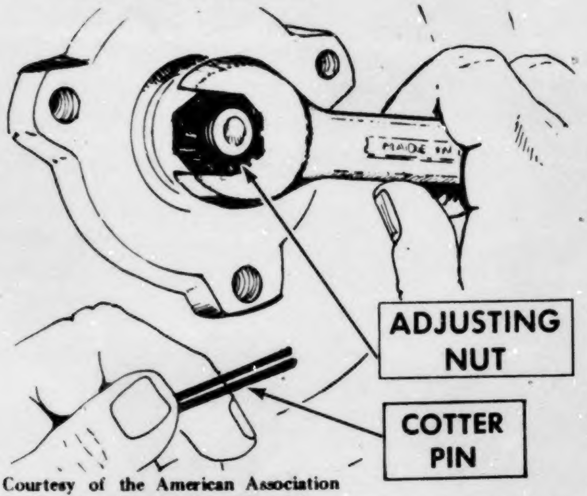


Figure 2 Remove the thrust washer and outer bearing.

Courtesy of the American Association for Vocational Instructional Materials



Courtesy of the American Association for Vocational Instructional Materials

Figure 1 Remove the cotter pin and adjusting nut.

5. Clean all parts thoroughly. (Caution: Use only mineral spirits, diesel fuel, kerosene or agitene as a solvent to clean the bearing. Never use gasoline. If high pressure air is used to dry the bearing, make certain you do not let the bearing spin since this may damage your bearing. Never strike a bearing with a hammer or object. The bearing may explode and cause bodily injury.)
6. Inspect bearing cups and cones for wear or damage. Replace if necessary.

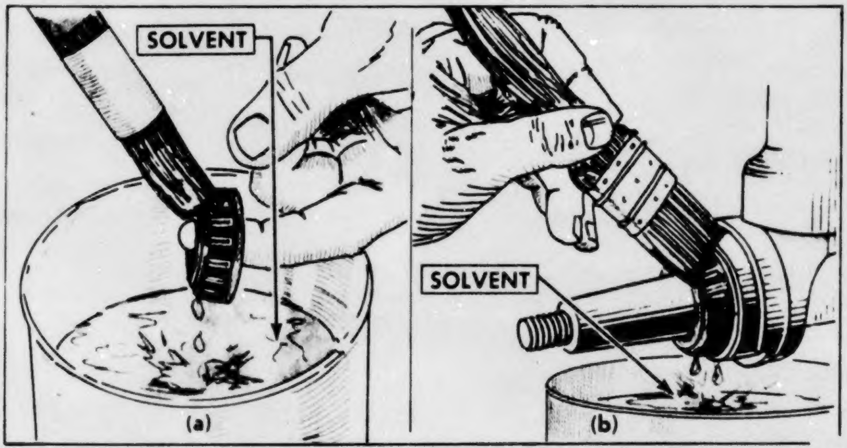


Figure 3 Use a stiff-bristle brush and solvent to remove old grease deposits whether the bearing is (a) removed from the hub, or (b) still attached to the spindle.

Courtesy of the American Association for Vocational Instructional Materials

7. Pack each bearing with No. 2 lithium grease. Fill the space around each roller.

8. Install bearing cups, inner bearing cone, and new seal.

9. Lubricate the seal surfaces with No. 2 lithium grease.

10. Install outer cone into the hub.

11. Install hub assembly onto the spindle.

12. Install the thrust washer until the pressure causes a drag while the hub and wheel is turned. Back off the nut until the next slot in the nut lines up with the hole in the spindle. If any end play is noticed, tighten the nut. (Torque according to specifications in the specific manufacturer's manual.)

13. Lock the slotted adjusting nut with a new cotter pin and reinstall the hub cap. Remove jack.

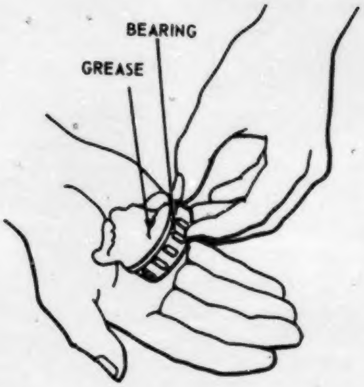


Figure 4 Packing grease into a bearing

Courtesy of John Deere and Company

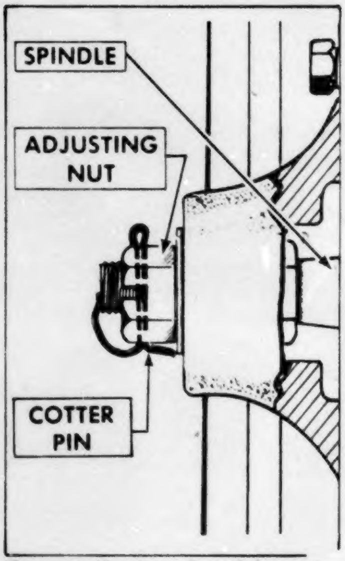


Figure 6 Bend one leg of the cotter pin over the end of the spindle. Bend the other leg over the adjusting nut.

Courtesy of the American Association for Vocational Instructional Materials

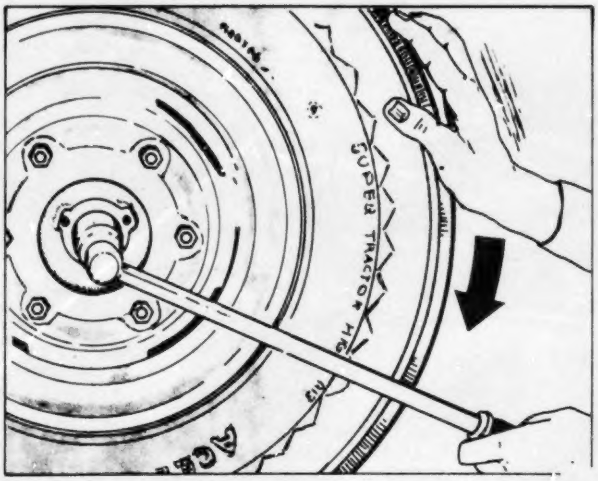


Figure 5 Tighten the nut until the wheel 'drags', then loosen.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF CHECK

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PACKING THE WHEEL BEARINGS

Answer the following:

1. What types of lubricant should you use in packing wheel bearings?

2. List four approved cleaning fluids for bearings.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

3. Most farm tractors will have ________________ bearings.

4. How much should you back the nut off after there is a drag?

5. Compressed air must be used with care since high pressure air flow can cause the bearings to explode. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, PACKING WHEEL BEARINGS.

Pack the wheel bearings on the designated tractor.

CORRECT RESPONSES

1. No. 2 lithium grease
2. Mineral spirits, diesel fuel, kerosene, agitene
3. Tapered-roller
4. Until the nearest slot in the nut and spindle or 1/6 to 1/3 turns.
5. True

DO NOT WRITE ON THIS PAGE

LAP TM–74

Student ____________________

Date ____________________

PACKING WHEEL BEARINGS
Instructor's Final Checklist

Check the student's performance in the following elements of packing wheel bearings.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In packing the wheel bearing, the student:				
a. locked the tractor brakes	[ ]	[ ]	[ ]	[ ]
b. removed bearings and seals with no damage to parts	[ ]	[ ]	[ ]	[ ]
c. cleaned all parts thoroughly	[ ]	[ ]	[ ]	[ ]
d. packed each bearing with No. 2 lithium grease	[ ]	[ ]	[ ]	[ ]
e. installed bearing cups, inner bearing cones, and new seal	[ ]	[ ]	[ ]	[ ]
f. installed outer cone into the hub	[ ]	[ ]	[ ]	[ ]
g. tightened the nut against the thrust washer until the wheel had a slight drag and then backed the nut off to the next slotted hole in the spindle	[ ]	[ ]	[ ]	[ ]
h. checked wheel for excessive play	[ ]	[ ]	[ ]	[ ]
i. installed new cotter pin and reinstalled hub cap	[ ]	[ ]	[ ]	[ ]
2. The wheel, after having the bearing packed by the student:				
a. turned freely with a minimum amount of end play	[ ]	[ ]	[ ]	[ ]
b. exhibited little or no drag	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 75

Adjusting Wheel Bearings

Tractor Mechanics

Courtesy of John Deere and Company

Objective nos. 1,2

INTRODUCTION

Many of the tractors a mechanic will bring into the shop will need the front wheel bearings adjusted. This is very important since most tractor manuals call for packing wheel bearings after 500 hours of service. Wheel bearings that are not properly adjusted will cause excessive wear on the bearing. Often wear is not noticed until it is too late to avoid costly repairs. In this learning activity package you will learn how to properly adjust the wheel bearings on a tractor.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 3 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

1. Given a basic mechanic's tool set, jack, and safety stand, manually adjust the wheel bearings on an assigned tractor. The adjusted wheel should roll freely with no loose motion.

2. Given a low-measuring (inch-pound) torque wrench, other basic tools, jack, and safety stand, adjust wheel bearings on the assigned tractor to the torque specified in the manufacturer's service manual.

LEARNING ACTIVITIES:

1. READ *Fundamentals of Machine Operation: Preventive Maintenance* (Deere & Company), p. 173.

   (or)____________________

2. READ Instructions, ADJUSTING WHEEL BEARINGS.

   (or)____________________

3. CHECK YOUR KNOWLEDGE of wheel bearings by taking the Student Self-Check, WHEEL BEARINGS.

4. REVIEW the section on adjusting wheel bearings in the manufacturer's service manual for the designated tractor.

   (or) The I & T Shop Manual

5. OBSERVE another student as he or she satisfactorily performs and is checked out on this package.

   (or)________________________

6. PRACTICE removing the cotter pin and hub and adjust the wheel bearings on an assigned tractor. Follow the procedure outlined in Instructions, ADJUSTING WHEEL BEARINGS.

7. ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 3.

TOOLS AND EQUIPMENT NEEDED

Mechanics's tool kit
Hydraulic Jack
Safety Stands
Torque wrench

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

Make sure tractor is securely resting on safety stands.

INSTRUCTIONS

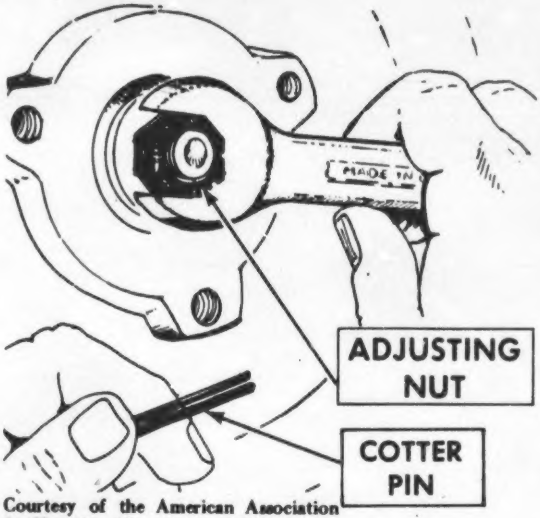
ADJUSTING WHEEL BEARINGS

While manually adjusting the wheel bearings, the following procedure should be followed:

.1 Raise tractor with jack; place safety stand under axle.

2. Remove dust cover with lock-joint utility pliers.

3. Remove cotter pin.



Courtesy of the American Association for Vocational Instructional Materials

Figure 1 Remove the cotter pin and adjusting nut.

4. Rotate (spin) wheel.

5. Tighten nut until slight resistance is felt.

Courtesy of the American Association for Vocational Instructional Materials

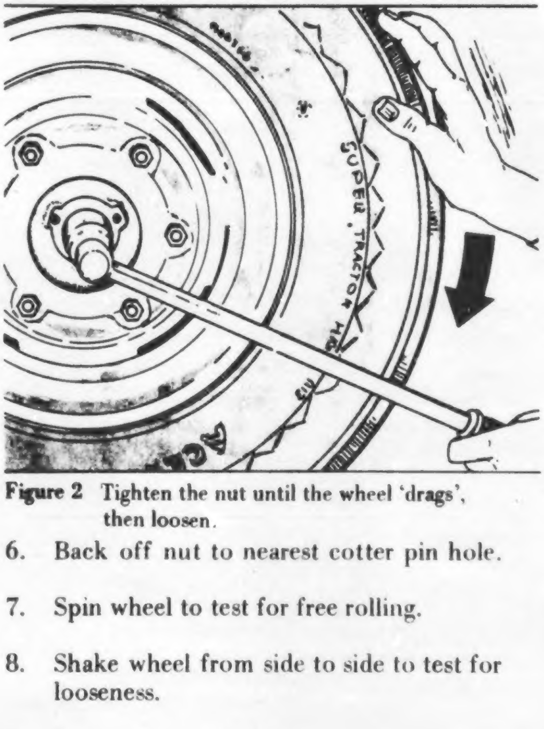


Figure 2 Tighten the nut until the wheel 'drags', then loosen.

6. Back off nut to nearest cotter pin hole.

7. Spin wheel to test for free rolling.

8. Shake wheel from side to side to test for looseness.

9. Install new cotter pin.

10. Replace dust cover.

While adjusting the wheel bearing with a torque wrench, the following procedure should be followed:

1. Clean and remove dust cover with lock-joint utility pliers.
2. Remove cotter pin.
3. Raise tractor with jack.
4. Check torque specifications.
5. Tighten to specifications with correct socket.

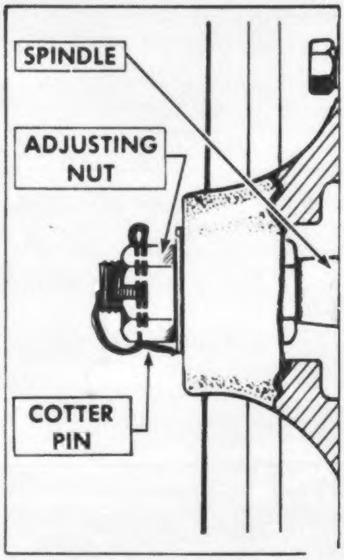


Figure 3 Bend one leg of the cotter pin over the end of the spindle. Bend the other leg over the adjusting nut.

Courtesy of the American Association for Vocational Instructional Materials

6. Install new cotter pin.
7. Replace dust cover.
8. Lower tractor with jack.

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

WHEEL BEARINGS

1. Most tractor manuals recommend that wheel bearing s be packed every
   a. 500 hrs.
   b. 1,000 hrs.
   c. 2,000 hrs.

2. Wheel bearings should be tightened
   a. Until the nut squeaks
   b. Until firmly tight -then back off about ½ turn
   c. Until the nut is flush with the end of the threaded spindle.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING WHEEL BEARINGS.

Manually adjust the wheel bearings on the assigned tractor.

Using the torque wrench, adjust the wheel bearings to specifications on the assigned tractor.

CORRECT RESPONSES

1. a
2. b (however, manufacturers do vary and give recommended specific torques).

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DO NOT WRITE ON THIS PAGE

LAP **TM–75**

Student ______________________________

Date ______________________________

ADJUSTING WHEEL BEARINGS

Instructor's Final Checklist

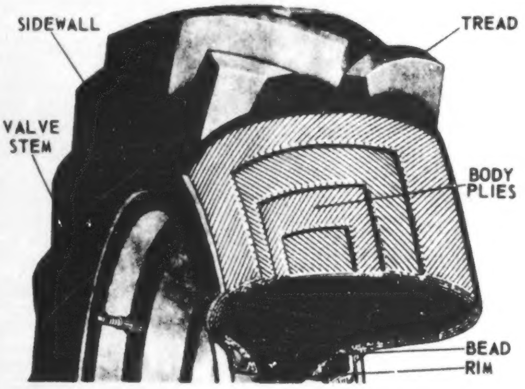
Check the student's performance in the following elements of adjusting wheel bearings.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. While manually adjusting the wheel bearings, the student:				
a. locked the brakes	☐	☐	☐	☐
b. placed safety stands under the raised tractor	☐	☐	☐	☐
c. rotated (spun the wheel and tightened until there was a slight drag)	☐	☐	☐	☐
d. backed off the nut to the nearest cotter pin	☐	☐	☐	☐
e. spun the wheel to test for free rolling	☐	☐	☐	☐
f. shook the wheel from side to side to test for looseness	☐	☐	☐	☐
g. installed new cotter pin and replaced the cover	☐	☐	☐	☐
2. The wheel, after being adjusted by the student:				
a. turned freely with a minimum amount of end play	☐	☐	☐	☐
b. exhibited little or no drag	☐	☐	☐	☐

Learning Activity Package Number 76



Courtesy of John Deere and Company

Inspecting Tires

Tractor Mechanics

Objective no. 3

INTRODUCTION

Unfortunately, many tractor operators seldom check their tractor tires for proper air pressure or defects. As a mechanic, you should check the tire pressure on all the tractors that come into the shop. Good tires with the proper pressure will result in safer operating conditions for the operator and less "down time" caused by such problems. In this learning activity package you will learn how to examine tires for wear and defects and how to check tires for proper inflation.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, go through the Learning Activities in the order given.

OBJECTIVE

Given a tractor with worn and damaged tires, a jack, and a tire gauge, check the tires for proper inflation and visually examine tires for wear and defects. Tire pressure must be 100% accurate as indicated in the manufacturer's specfications and all defects should be identified.

LEARNING ACTIVITIES

1. READ *Fundamentals of Service: Tires and Tracks* (Deere & Co.) pp. 6-7, 16-19.

   (or)____________________

2. CHECK YOUR KNOWLEDGE of tire inflation by taking the Student Self-Check, DEFECT CHECK LIST.

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3. READ Instructions, INSPECTING TIRES.

4. STUDY the section on inspecting tires in the manufacturer's service manual for the designated tractor.

   (or) The I & T Shop Manual

5. OBSERVE another student as he or she satisfactorily performs and is checked out on this package.

6. PRACTICE checking the tires on the designated tractor for wear, pressure and defects. Follow the procedure outlined in Instructions, INSPECTING TIRES. Use Student Self-Check 1, DEFECT CHECKLIST.

   (or)____________________________

7. ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Tire gauge
Hydraulic jack

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

Make sure the tractor is securely resting on a jack or jack stand.

INSTRUCTIONS

INSPECTING TIRES

While inspecting tires, the following procedure should be used:

1. Raise tractor to permit rotation of tires.

2. Use standard pressure gauge to measure PSI. (Place valve stem at top of rotation to test fluid filled tires.)

3. Inflate to PSI as indicated by tire manufacturer.

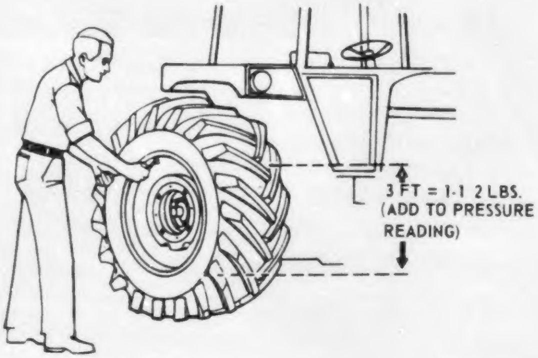
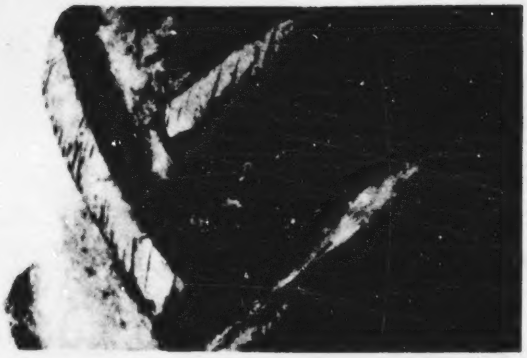


Figure 1 Optional method of checking air pressure with valve stem at the top

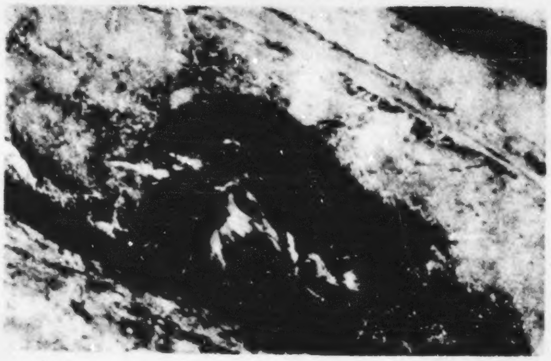
Courtesy of John Deere and Company

4. Visually inspect tires for defects, tread and sidewall cuts, fabric breaks, rubber checks, stubble wear, valve damage, and tread wear.

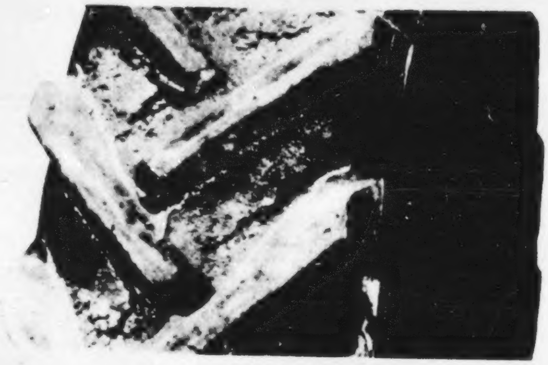
IMPACT BREAK



SPINNING WEAR



EMBEDDED STONE



Courtesy of John Deere and Company

STUBBLE WEAR

Figure 2 Damage caused by tire abuse

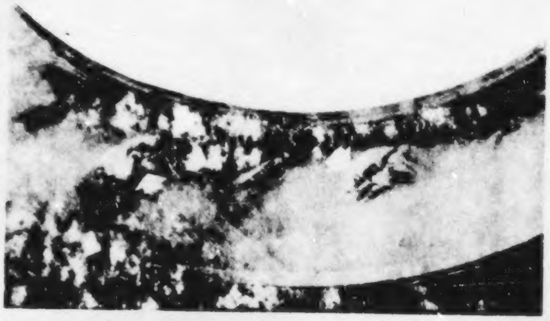


Figure 3 Damage caused by underinflation

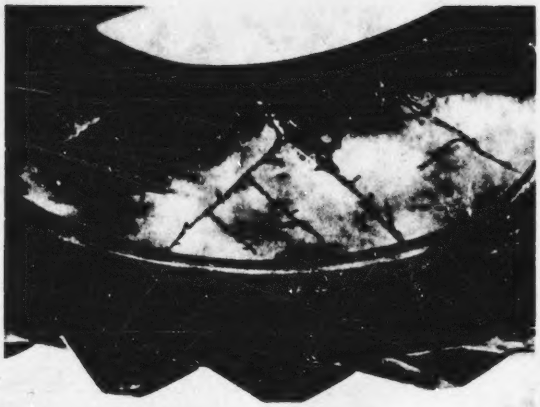
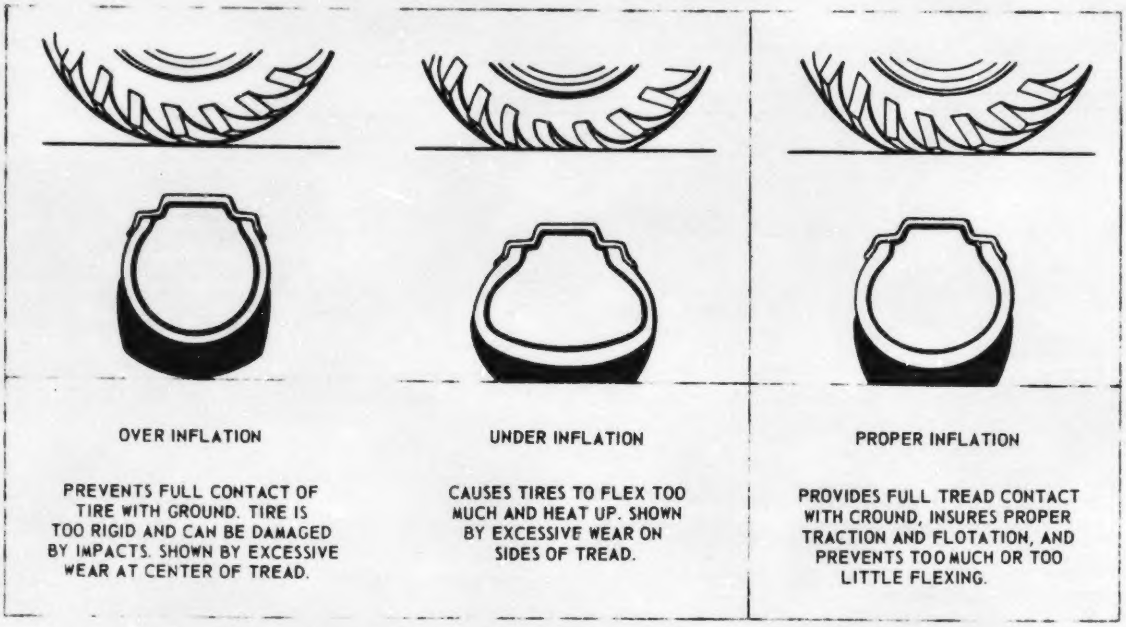


Figure 4 Damage caused by overinflation

Courtesy of John Deere and Company

5. Lower tractor to ground and check proper shape of tire (contact of tread with ground).



OVER INFLATION

PREVENTS FULL CONTACT OF TIRE WITH GROUND. TIRE IS TOO RIGID AND CAN BE DAMAGED BY IMPACTS. SHOWN BY EXCESSIVE WEAR AT CENTER OF TREAD.

UNDER INFLATION

CAUSES TIRES TO FLEX TOO MUCH AND HEAT UP. SHOWN BY EXCESSIVE WEAR ON SIDES OF TREAD.

PROPER INFLATION

PROVIDES FULL TREAD CONTACT WITH CROUND, INSURES PROPER TRACTION AND FLOTATION, AND PREVENTS TOO MUCH OR TOO LITTLE FLEXING.

Figure 5 Tire inflation

Courtesy of John Deere and Company

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
DEFECT CHECK LIST

Use the checklist below when inspecting tires:

a. defects in manufacturing

b. tread and sidewall cuts

c. fabric breaks

d. rubber checks

e. stubble wear

f. valve damage

g. tread wear

h. tire pressure reading ____________________

i. tread contact with surface (See illustrations on Instruction Sheet I.)

under inflation ____________________

over inflation ____________________

proper inflation ____________________

Compare your ratings with those of the Instructor.

CHECK–OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, INSPECTING TIRES.

Check tires on the designated tractor for proper inflation, and identify defects and wear.

DO NOT WRITE ON THIS PAGE

LAP TM–76

Student ______________________

Date ______________________

INSPECTING TIRES

Instructor's Final Checklist

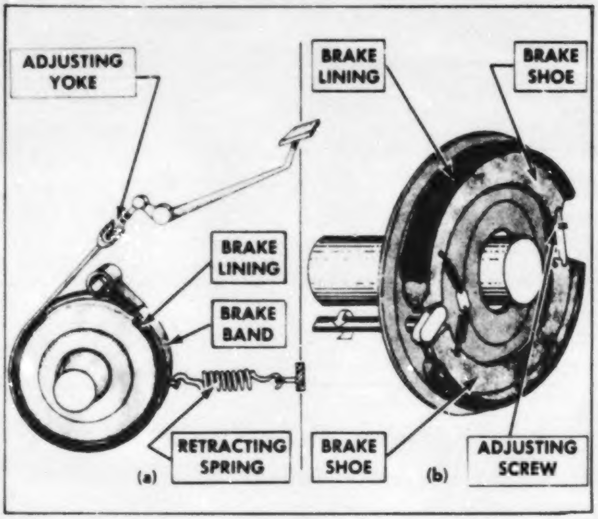
Check the student's performance in the following elements of inspecting tires.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. While inspecting the tires, the student:				
a. raised the tractor to permit rotation of the tire	[ ]	[ ]	[ ]	[ ]
b. checked the manufacturer's service manual for the proper air pressure	[ ]	[ ]	[ ]	[ ]
c. placed the valve stem at the top of the rotation while testing fluid- filled tires	[ ]	[ ]	[ ]	[ ]
d. inflated the tires to the manufacturer's specifications	[ ]	[ ]	[ ]	[ ]
e. correctly identified defects, stubble wear, valve damage and tread wear	[ ]	[ ]	[ ]	[ ]
2. The student's tire pressure reading agreed with the instructor's	[ ]	[ ]	[ ]	[ ]
3. The student's tire faults list agreed with the instructor's	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 77



Repairing Brake Assemblies

Tractor Mechanics

Objective no. 11

Courtesy of the American Association
for Vocational Instructional Materials

INTRODUCTION

Some of the tractors which will be brought into the shop will have faulty braking systems. The braking system must be in good condition if the equipment is to be operated safely. On tractors, the braking system will be either hydraulic or manual. The brakes will be located on each drive wheel. In this learning activity package you will learn how to correctly repair the brake assembly.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the manufacturer's service manual and the necessary tools and replacement parts, service a dry clutch. When servicing is complete, the clutch must operate according to manufacturer's specifications, and there should not be excessive lubrication of the bearings or release fork.

LEARNING ACTIVITIES

1. READ Fundamentals of Machine Operation: Preventive Maintenance (Deere & Company), pp. 144, 175-179.

   (or)____________________

2. VIEW film strip and tape cassette, "The Brake System Explained" (Bergwall Productions, Inc.), slides 1-6.

   (or)____________________

3. CHECK YOUR KNOWLEDGE of brake assemblies by taking the Student Self-Check, BRAKE ASSEMBLIES

4. READ Instructions, REPAIRING BRAKE ASSEMBLIES.

   (or)____________________

5. STUDY the section on repairing brake assemblies in the manufacturer's service manual for the designated tractor

   (or) The I & T Shop Manual

6. OBSERVE another student as he or she satisfactorily performs and is checked out on this package.

   (or)____________________

7. PRACTICE repairing the brake assembly on the designated tractor. Follow the procedure outlined in Learning Activity 3.

   (or)____________________

ARRANGE with your instructor to complete this learning activity package by going through the CHECK – OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit
Hydraulic jack
Brake tool set

MATERIALS AND SUPPLIES-NEEDED

Recommended solvent
Cleaning rags
Replacement parts

SAFETY

Make sure the tractor is securely mounted on stands.

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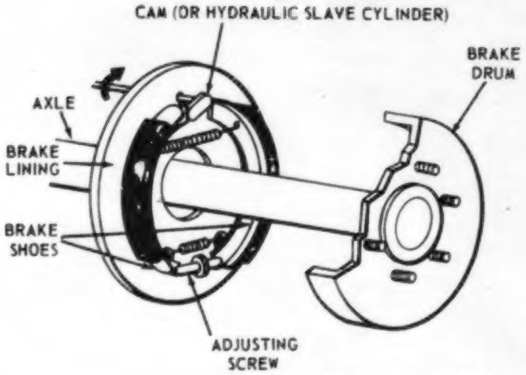
REPAIRING BRAKE ASSEMBLIES

In repairing the brake assemblies, the following procedure should be used:

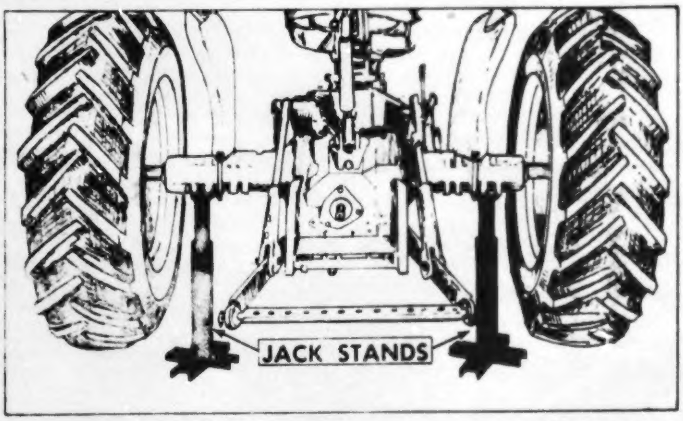
> (Note: There are several types of brake assemblies. Check manufacturer's service manual for specific details.)

1. Block wheels.
2. Jack up tractor and remove wheel.
3. Pull off brake drum.
4. Remove shoe retainers.
5. Remove shoes.
6. Clean all parts and inspect for excessive wear.
7. Replace shoes with rebuilt shoes.
8. Replace all worn parts as necessary.
9. Reinstall shoes and hardware, including return springs, adjusting mechanism and shoe retainers.
10. Reinstall drum. (Have drum turned if deeply grooved.)
11. Reinstall wheel.
12. Adjust brake shoes to manufacturer's specifications.
13. Repeat procedure for other wheel.



Courtesy of John Deere and Company

Figure 2. Shoe brakes.



Courtesy of the American Association for Vocational Instructional Materials

Figure 1. Before adjusting brakes, jack up rear of tractor until both wheels clear the ground.

STUDENT SELF CHECK

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BRAKE ASSEMBLIES

1. List at least two types of brakes commonly used on tractors:

   a. ____________________

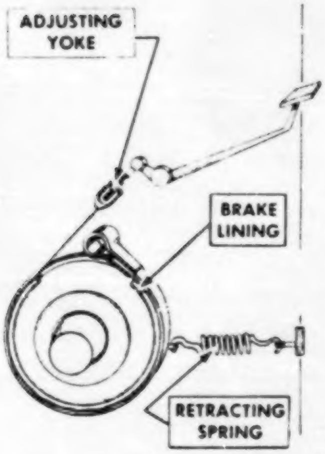
   b. ____________________

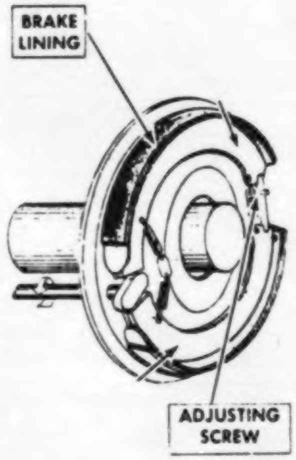
2. Label the following as to type of braking system:

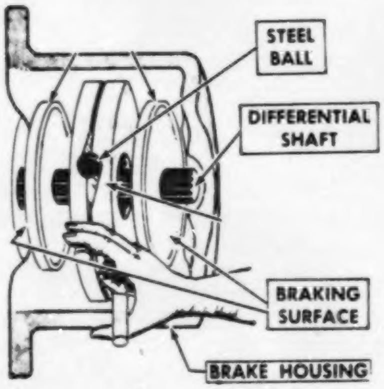
CHECK–OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPAIRING BRAKE ASSEMBLIES.

Repair the brake assembly on the designated tractor.


ADJUSTING YOKE
BRAKE LINING
RETRACTING SPRING


BRAKE LINING
ADJUSTING SCREW


STEEL BALL
DIFFERENTIAL SHAFT
BRAKING SURFACE
BRAKE HOUSING

a. ____________ b. ____________ c. ____________

CORRECT RESPONSES

1. band
   shoe
   disc
   set-type hydraulic disc

2. a. band
   b. shoe
   c. disc

DO NOT WRITE ON THIS PAGE

LAP TM–77

Student ____________________

Date ____________________

REPAIRING BRAKE ASSEMBLIES

Instructor's Final Checklist

Check the student's performance in the following elements of repairing brake assemblies.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In repairing the brake assembly the student:				
a. raised tractor wheel safely	[ ]	[ ]	[ ]	[ ]
b. correctly removed the brake drum, shoe retainers, and brake shoes	[ ]	[ ]	[ ]	[ ]
c. cleaned all parts	[ ]	[ ]	[ ]	[ ]
d. inspected all parts for wear	[ ]	[ ]	[ ]	[ ]
e. replaced all worn parts as necessary	[ ]	[ ]	[ ]	[ ]
f. turned drum if deeply grooved	[ ]	[ ]	[ ]	[ ]
g. correctly reinstalled the shoes and hardware, including return springs, adjusting mechanism and shoe retainer	[ ]	[ ]	[ ]	[ ]
h. adjusted brake shoes to manufacturer's specifications	[ ]	[ ]	[ ]	[ ]
2. The brakes, after being repaired by the student:				
a. exhibited no drag	[ ]	[ ]	[ ]	[ ]
b. were both adjusted to catch at the same time	[ ]	[ ]	[ ]	[ ]